No. 2640 VOLUME 76 FRIDAY 16 OCTOBER 1959

FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded 1909

Editor-in-Chief
MAURICE A. SMITH D.F.C.

Editor
H. F. KING M.B.E.

Technical Editor
W. T. GUNSTON

Production Editor
ROY CASEY

IN THIS ISSUE

Supersonic Air Transport 392

Deadlier than the Male 397

Anglo-American Conference 398

Photography in Aircraft Development 400

Rotary Quadrille 401

Living High 402

Lockheed Electra 404

Ilyushin Il-18 405

Sell and Forget? 406

Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1; telephone Waterloo 3333. Telegrams Flightpres Sedist London. Annual subscriptions: Home £4 15s, Overseas £5. Canada and U.S.A. $15.00. Second Class Mail privileges authorized at New York, N.Y.

Branch Offices Coventry: 8-10 Corporation Street; telephone Coventry 25210. Birmingham: King Edward House, New Street, 2; telephone Midland 7191. Manchester: 260 Deansgate, 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow: 26B Renfield Street, C.2; telephone Central 1265.
New York, N.Y.: Thomas Skinner & Co. (Publishers) Ltd., 111 Broadway, 6; telephone Digby 9-1197.

© Iliffe & Sons Ltd., 1959. Permission to reproduce illustrations and letterpress can be granted only under written agreement. Brief extracts or comments may be made with due acknowledgement.

Summit Conference

HALF a century ago the summit of the aeronautical world was France. There it was that the art of flying found its patronage, and there, too, were nurtured the first strong growths of precept and practice. The very language of the air was redolent of France, and every standard of achievement was set within her boundaries. Today America commands the aeronautical eminence; and as France gave to posterity the *fuselage* and *aileron* so has America contributed conical camber and the buddy pack.

Thus, when leaders of American thought are at home to their British and Canadian fellows (as they have been in recent days at the Anglo-American Conference) then comparisons become, not odious, but the essence of the occasion. When Harry Smith observes to Gaylord P. Humdinger that the Humdinger concept of hyperbolic productivity is interesting—indeed, challenging—he is really wondering how the boys back home are going to adjust their own ideas to meet that same interesting challenge. So we shall be abusing no hospitality or privilege if we consider with candour the British contribution to an occasion that has pleased Her Majesty the Queen to describe as "stimulating" and "heart-warming."

Take first the speech by Sir Aubrey Burke, who received the Elmer A. Sperry Award on behalf of the de Havilland Aircraft Company, makers of the Comet airliner and of aeronautical history. Having stated the case for the Comet in the past and the present Sir Aubrey gave notice that the men who built it are already immersed in the problems of a second and a third generation of jet airliners. In other words de Havilland have faced those two imposters, triumph and disaster, and have treated them, as Kipling counselled, just the same. Even more to the point, they are playing for big stakes and they are playing for keeps.

Bearing Gifts

And what of the papers read by British and Canadian delegates? Did they impart new knowledge to the Americans, either intrinsically or in the discussions they promoted; or were they empty symbols of social and technical formality? It is difficult, of course, to determine the value of certain of the papers in the estimation of the American engineers and scientists, though any authoritative survey of a universal problem must be of service, be it by Atkinson on aircraft fatigue, Cornford, King-Hele and Merson on recent studies of satellite orbits, Gadd and Holder on the behaviour of supersonic boundary-layers in the presence of shock-waves, Heath on design philosophy for high acceleration and temperature, Whitfield on the future of automatic control of fixed-wing aircraft, Bull on re-entry studies in free-flight ranges, or Metcalfe on considerations of shape and control for hypersonic vehicles. A more positive assessment is possible in respect of others among the British papers. For instance, Hiscock's story of the Caribou utility STOL aircraft concerns a Commonwealth product which not only interests the Americans, but was actually sponsored by them. Respecting *Engines for VTOL Aircraft* (Pearson), we in Britain can soberly reassure ourselves that we are definitely one-up on the Americans—the accolade; and the same goes for *Work of the Blind Landing Experimental Unit* (Charnley). Walter Tye's review of *Unresolved Civil Airworthiness Problems* is a major contribution, if not to international knowledge, then certainly to understanding.

So while we in Britain unreservedly acknowledge America as the aeronautical summit we can note that the British delegates attended not as poor relations but as close friends and keen rivals. Not cap in hand, but bearing gifts.

FROM ALL QUARTERS

An Aviation Ministry?

POST-ELECTION speculation as to Ministerial responsibility in the new cabinet includes suggestions that a separate Ministry of Aviation will replace the M.T.C.A. By annexing some of the duties of the Ministry of Supply, the new Ministry might also (it is suggested) be responsible not only for operational aspects of B.E.A. and B.O.A.C. but also for control of aircraft purchasing. And some of the research work now tackled under the auspices of the M.o.S. might be taken over by a new "Ministry of Science."

The appointment of a Minister solely concerned with aviation has been repeatedly urged by many who feel that control of Britain's civil flying is onerous enough for any one man without burdening him with the responsibility for surface transport and road reconstruction. If there is to be new Government investment in the aircraft industry a Ministry of Aviation might then take responsibility for the overall direction of research. The supersonic airliner seems to be an obvious case where very clear direction will be required.

Griffon Achieves 1,447 m.p.h.

AT Istres on October 5 the second Nord Griffon, piloted by André Turcat, achieved Mach 2.19 at about 50,000ft. This aircraft is now resuming a series of high-speed tests for the study of specific consumption of the combined turbo-ramjet (one SNECMA Atar plus one Nord ram unit) and of the thermal phenomena affecting structure and equipment. Although no claim for a record has yet been advanced, the equivalent figure of 1,447.6 m.p.h. exceeds the Lockheed Starfighter's world record of 1,404 m.p.h. by 43.6 m.p.h.

Swiss Hunters and P-16s

THE handsome Hawker Hunter Mk 66A two-seater G-APUX, used by Bill Bedford for his Farnborough spinning demonstrations, has been leased to the Swiss Air Force for evaluation. It is further learned that of the 100 Hunter Mk 58s ordered by the Swiss Government about a year ago, 70 have been delivered. They are flown by both Regular and Auxiliary pilots. On September 25 the fourth prototype of the FFA P-16 (Mk 3) was demonstrated to journalists. It has a Bristol Siddeley Sapphire ASSa.7 of 11,000 lb thrust. Another prototype is under construction, but no production is contemplated.

More Hoverers from I.o.W.

NOW under development at Bembridge, Isle of Wight, by Britten-Norman Ltd., is an air-cushion vehicle which could form the prototype for a new machine for crop-spraying applications. The craft is at an early stage of construction and is a test vehicle only, with no practical application; the company are exploring the possibilities of a vehicle for their associate company Crop Culture (Aerial) Ltd., which would be suitable for agricultural use in remote areas where road transport is difficult. The idea of an air-riding vehicle, they say, is a straightforward transport development—the logical next step of "removing the cover from the tubeless tyre."

Marconi Defence for Sweden

A CONTRACT worth £1.5m has been placed by the Swedish Government with Marconi's Wireless Telegraph Co. through their Swedish associates, Svenska Radio Aktiebolaget, for a new air-defence control system. An underground cavern at a secret location is now being excavated in Sweden to accommodate the new system, which was designed jointly by Marconi and R.S.A.F. engineers. Further centres may later be set up to cover the remainder of Swedish territory.

In the new Marconi system it is reported that aircraft or missiles are detected by various types of radar and then automatically tracked. Vector and height information are fed into an "information bank," using digital techniques, and continuously kept up to date. Information on defence dispositions is also stored and a new high-speed computer solves the interception problems and automatically transmits instructions to aircraft or missile sites. Special tabular and synthetic displays are supplemented by televised pictures of ancillary operational information, such as weather charts, and the air situation as a whole is shown on large-screen television projection displays. The human element in the chain is reduced to the minimum.

The new system has been described by a Swedish Government representative as "the most technically advanced in Europe, probably in the world," and deliveries of the electronic equipment are to start as soon as the underground accommodation is ready for it.

Sir Henry Tizard

WE record with regret the death, on Friday, October 9, of Sir Henry Tizard, G.C.B., A.F.C., F.R.S. He was 74 years of age. Born on August 23, 1885, Henry Thomas Tizard showed an early interest in mathematics, science and chemistry. In 1915 he was transferred from the Army to the Central Flying School at Upavon. He attained the rank of lieutenant-colonel and became Assistant Controller, Experiments and Research, Royal Air Force, which post he held until 1919. After various senior industrial and academic appointments he was made chairman of the Aeronautical Research Committee in 1933, a post he held for ten years. He was a member of the Council of the Minister of Aircraft Production and was made an additional member of the Air Council in 1941. From 1946 until 1952 he was chairman of the Advisory Council on Scientific Policy and the Defence Research Policy Committee.

Sir Henry was elected President of the British Association in 1948. He was made a C.B. in 1927, a K.C.B. in 1937, and G.C.B. in 1949.

Redifon Order from Yugoslavia

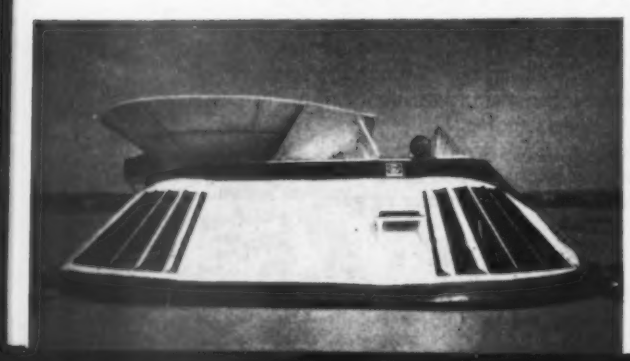
A YUGOSLAV purchasing commission recently in London placed with Redifon Ltd. orders valued at £55,000 for radio equipment to be installed at the new Surcin Airport at Belgrade and at other points in Yugoslavia. The contract calls for 37 transmitters for beacon and communications services, and much associated equipment. Redifon remark that as a number of their beacons have been operating in Yugoslavia for some time past the new contract implies that these have given complete satisfaction.

A Real Hustler

ALTHOUGH the changing climate of American defence spending appears to have curtailed the life of the Convair B-58 Hustler by some years, the type will still see squadron service with the U.S.A.F. Strategic Air Command. Earlier this month Convair announced the new escape system which should increase the chance of survival of Hustler crews after ejecting at up to 1,300 m.p.h. and alighting in a hostile environment.

Developed by Stanley Aviation Corp., of Denver, the capsule encloses a single seat, and the B-58 carries three in tandem for the pilot, navigator and systems engineer. According to Convair the encapsuled seat will render redundant "bulky personal flight clothes and equipment" and will permit SAC's alert concept to be met while preserving "shirt-sleeve comfort." Normally open

BUBBLE CAR: Offered by Curtiss-Wright for quick delivery, the Air Car is an air-riding four-seater with a 300 h.p. engine. It measures 21ft in length, weighs 2,800 lb, and is capable of speeds up to 60 m.p.h. After the general view comes a close-up of the air intake; and finally there is a view of the cockpit. Another example, with twin fans, is now operating



MORE NEW SHAPES: Above is a new "scooter craft" under development at Princeton University, New Jersey. It works on the Hovercraft principle and the United States Army has supplied the funds. The only controls are a pair of handlebars. At upper right is the Doak 16 (VZ-4da) VTOL research aircraft on its first cross-country flight (the ducted fans on the wing-tips rotate through 90 deg). Last is an impression of a "saucer" project—another effort by Princeton University. Construction is well advanced, and it is expected that a 45 h.p. engine will provide lift and a 25 m.p.h. forward speed by forcing air through vents around the periphery

at the top, each capsule is sealed at the beginning of the ejection cycle and, after descent by parachute, provides an airman with a habitable environment until a rescue team can home on the capsule's radio.

A fortnight ago a Convair crew flew a B-58 on a 1,400-mile low-level mission from Fort Worth to Edwards A.F.B. Flying at over 700 m.p.h., the aircraft traversed terrain up to 9,000ft above sea level but was never more than 500ft from the ground. A dramatic demonstration of flexibility and penetrative ability, the mission took 2 hr outbound and did not tire the crew; the return trip (unrefuelled) was made in the same time but at high altitude.

NA.39 Lost

A BLACKBURN NA.39 was destroyed in a crash near Lyndhurst, in the New Forest, last Monday. William Alford, a civilian test pilot attached to the U.S. Office of Naval Research, and John Joyce, a Blackburn flight-test observer, were killed.

The aircraft, which was on test from Boscombe Down, was one of the first seven now flying from the development batch of 20 (on September 20 it was announced that this order had been followed by "a substantial production contract"). The manufacturers have been authorized to seek American orders.

Dowty-Rotol Amalgamation

AN amalgamation "in line with national policy" is announced by the Dowty Group. Having regard to the changing pattern of the aircraft industry and in the interests of economy, states the group, it is intended to merge Dowty Equipment Ltd. with Rotol Ltd. and its subsidiary British Messier Ltd.

The change will become effective on April 1, 1960, and it is proposed that the resulting single company shall operate under the name of Dowty Rotol Ltd.; joint managing directors will be Mr. C. J. Luby and Mr. E. J. Nicholl.

Dowty's acquisition of Rotol as a wholly-owned subsidiary was announced towards the end of 1958 and became effective early this year.

IN BRIEF

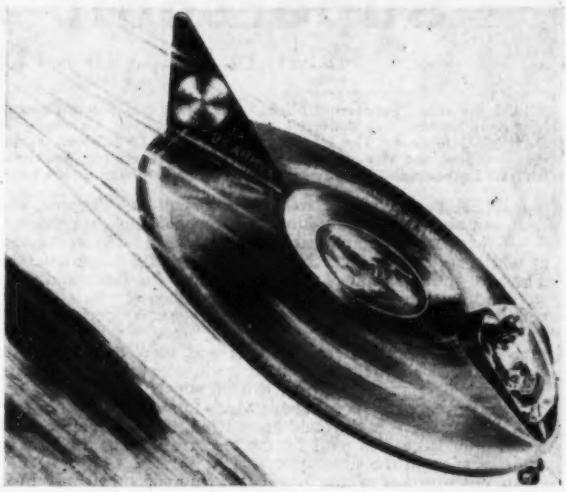
The council of the S.B.A.C., after considering the results of this year's Farnborough Flying Display and Exhibition, have already decided that the next one will as usual be held in the first full week of September next year.

The Indian Government has approved Rolls-Royce terms for the establishment of a plant at New Delhi to manufacture Dart engines, and the signature of an agreement was expected this week. The Darts will power the Indian-built Avro 748s.

A Victor B.1 fuselage is to be tank-tested at the R.A.E., Farnborough, in the hope that it may provide evidence to account for the so far unexplained disappearance of a Victor B.2 during a test-flight from Boscombe Down on August 20.

Dr. H. Roberts of Fairey Aviation is to speak about the Rotodyne at the next meeting of the Aircraft Recognition Society. This will be held next Wednesday—October 21—at the Royal Aeronautical Society, 2 Hamilton Place, London, W.1, at 7 p.m.

R.A.F. aircraft attending the opening of Rongotai Airport, Wellington, New Zealand, on October 24 are to circle the world in opposite directions. Three Vulcans from No. 617 Sqn., supported by a Britannia of No. 99 Sqn., are flying eastwards; and a Comet from No. 216 Sqn. is flying westwards. They will continue their round-the-world journeys after visiting New Zealand.



The Royal Aeronautical Society has placed an £80,000 contract with Holland & Hannen and Cubitts Ltd. for the construction of its new lecture theatre block.

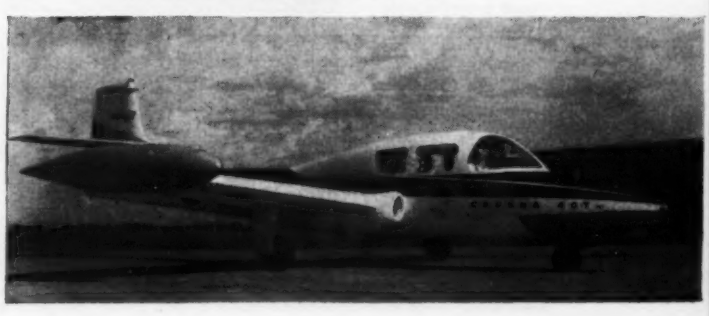
This week's (October 16) issue of our associated journal *The Autocar* is a Show Guide number, the first of three special issues covering the Motor Show at Earls Court (October 21-31).

Four Hiller 360s of Fison-Airwork Ltd. have been chartered by the French concern Compagnie Reynolds de Geophysique to assist in completing a geophysical survey in the Sahara. They are working from a base near Setar, a hundred miles south-east of El Golea in Algeria.

Air-Britain is holding its annual photographic competition at Caxton Hall, London, S.W.1, on November 4. There are three classes of subject: static aircraft, aircraft in motion (ground or air) and original views. Judges will be the chief photographer of B.E.A., Mr. Harry Stewart, and the chief photographer of Vickers-Armstrongs (Aircraft) Ltd., Mr. Leslie Sansom.

We regret to record that Sr. Mario Stoppani, the Italian aviator who between the wars set up 40 world records, died recently at his home at Varese aged 64. One of his records was for a non-stop flight of 4,350 miles from Italy to South America in 1937 in a three-engined Cant Z.506B seaplane. The aircraft came down in the Atlantic on the return journey and Stoppani was the only survivor.

GOOD LOOKER: The Cessna 407 (referred to on page 346 of last week's issue) is being promoted as a military utility jet although company-financed. The first example—seen here in mock-up form—bears U.S.A.F. markings and serial number



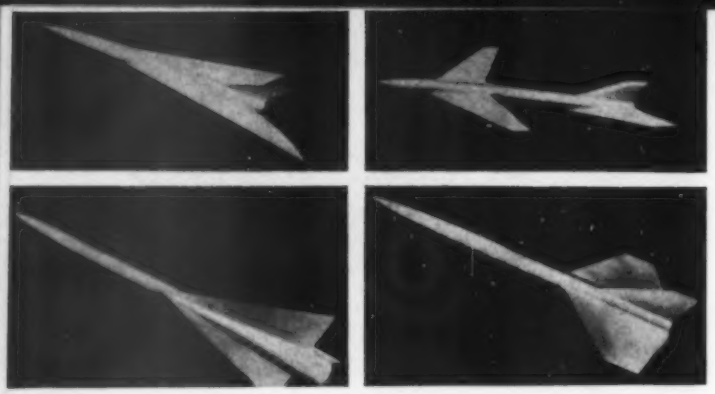


Fig. 1 (left). Lockheed wing/body arrangements for Mach 3 to 3.5 include, top left, a twisted and cambered swept wing; top right, a tandem wing; below left, a cone-delta; and below right, a trapezoidal wing. On page 411 is illustrated a more developed configuration for a Mach 3 to 3.5 airliner that the lecturer said could be operational in six years' time if a development programme were implemented now

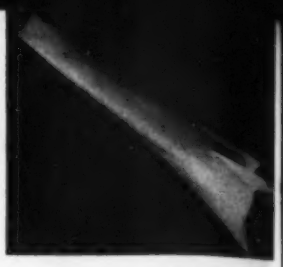


Fig. 3. An all-body, wingless VTOL design of low structural weight for Mach numbers of up to 7.0. The less aeroplane subjected to heating by air friction the better

Supersonic Air Transport

MR. HALL HIBBARD'S PLESMAN MEMORIAL LECTURE

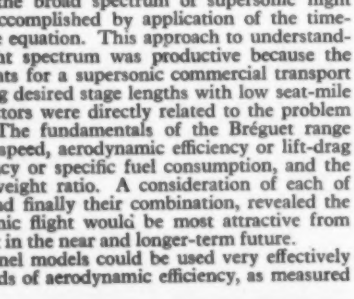
WITH the title "Supersonic Flight," the third Dr. Albert Plesman Memorial Lecture was delivered at the Technological University of Delft on October 6. The lecturer was Mr. Hall L. Hibbard, senior vice-president and vice-president in charge of engineering, Lockheed Aircraft Corporation. Given here is an abridged version of his paper

AFTER paying tribute to the memory of Dr. Plesman, and reviewing Western-World supersonic flight experience, Mr. Hibbard reminded his audience of the tremendous rate at which supersonic flight hours were currently being amassed. The high-speed aircraft of the United States Air Force and Navy were logging many thousands of hours per day, of which approximately 1,000 hours were at supersonic speed: "Let me repeat this—1,000 hours every day at supersonic speed." When the flight time of the other Western countries was added to this, it was estimated that approximately 400 more hours per day were being accumulated. In total, nearly a half-million hours per year were being experienced at speeds above Mach 1.0.

This impressive background and current rate of flight accumulation provided a firm basis for the forecasting of commercial air transportation in the supersonic area.

An investigation of the broad spectrum of supersonic flight speeds could best be accomplished by application of the time-honoured Bréguet range equation. This approach to understanding the supersonic flight spectrum was productive because the fundamental requirements for a supersonic commercial transport were related to achieving desired stage lengths with low seat-mile costs, both of which factors were directly related to the problem of fuel consumption. The fundamentals of the Bréguet range equation were cruising speed, aerodynamic efficiency or lift-drag ratio, propulsive efficiency or specific fuel consumption, and the aircraft initial-to-final weight ratio. A consideration of each of these factors in turn, and finally their combination, revealed the areas in which supersonic flight would be most attractive from a commercial standpoint in the near and longer-term future.

High-speed wind tunnel models could be used very effectively for establishing the trends of aerodynamic efficiency, as measured by maximum lift-drag ratios, throughout the supersonic speed range. For many years the aircraft industry had been exploring the supersonic and hypersonic speed range with various series of such models designed to verify the results of analytical and research studies in the Mach 3.0 to 3.5 region (Fig. 1).



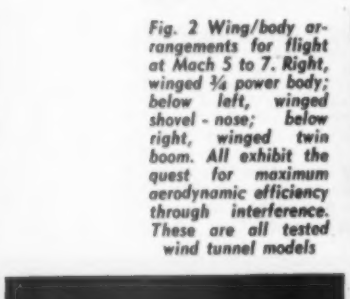


Fig. 2 Wing/body arrangements for flight at Mach 5 to 7. Right, winged ¾ power body; below left, winged shovel-nose; below right, winged twin boom. All exhibit the quest for maximum aerodynamic efficiency through interference. These are all tested wind tunnel models

A representative series of models had been designed to explore the higher Mach number region up to Mach 7.0 (Fig. 2). Here were three wing and body combinations in which the exploration for maximum aerodynamic efficiency through interference had been extended to the higher Mach regime. Body shapes and wing planforms of the shovel nose, twin boom, and 3/4-power body types were constructed to represent very accurately the results of theoretical studies.

An entirely different approach to "configuring" for high Mach number flight had also been explored. This was the all-body, or wingless, arrangement using vertical take-off and landing (Fig. 3). Attention had been directed to the wingless configuration because the lift-curve slope of a wing steadily decreased with increasing Mach number, approaching that of a body alone. The continual reduction in lift-efficiency of a wing-like configuration could result in the wingless arrangement becoming aerodynamically attractive at some hypersonic speed.

A prognosis could be made (Fig. 4) showing maximum aerodynamic efficiency trends throughout the supersonic and hypersonic speed range, based upon the studies described.

Mr. Hibbard went on to say that propulsive efficiency (the second Bréguet-equation ingredient) was best discussed in terms of the variation of minimum specific fuel consumption with Mach number for different powerplant types. At the present time it appeared that conventional turbojet engines would be used for Mach numbers up to approximately 3.5. Overlapping were dual-cycle or turbo-ramjet engines, which could be used for flight at speeds in the Mach 3.0 to 5.0 region. Optimum designs of pure ramjets could provide efficient propulsion to Mach 7.0 and above. (An estimate of the minimum specific fuel consumption which might be attained by these different powerplants was here illustrated by the lecturer.)

Available turbojet engine design techniques provided very attractive specific fuel consumption values to Mach 3.0-3.5, with a non-afterburning cycle, within today's knowledge. Above 3.0 to 3.5 these specifics could be expected to deteriorate rapidly, although we might also anticipate that experience and additional research would improve these values.

The aerodynamic and propulsive efficiency terms of the Bréguet range equation could be combined with flight speed to give a measure of range efficiency. (The lecturer here displayed Fig. 5, "this interesting parameter for both winged and wingless configurations.") A high-efficiency peak existed just below the sonic speed. Range efficiency was unattractive at speeds just above Mach 1.0, but a second area of interest was clearly revealed near Mach 3.0 to 3.5 with conventional turbojet engines. A possibility for very efficient operation at Mach numbers of 5.0 to 7.0 and above also existed with 1970 ramjets.

The final factor of the Bréguet range equation, the ratio of initial to final weight, had to be assessed through complete design studies of vehicles using the powerplants and configurations shown to be optimum. Such design studies had been carried out for transport aircraft designed for conventional take-off and having a maximum range of 3,500 nautical miles, plus reserves. The results of these design studies could be illustrated (Fig. 6) to show the percentages of gross weight allotted to equipment, structures, propulsion, fuel and payload.

At subsonic speeds, high range and structural efficiencies resulted in a substantial payload. This corresponded with the known performance of our long-range commercial transports of today. As the cruising speed approached Mach 1.0, the quantity of fuel

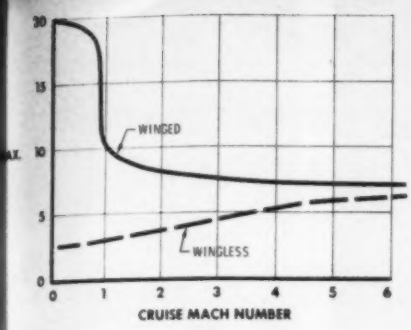


Fig. 4 (left). Maximum lift-drag ratio versus Mach number

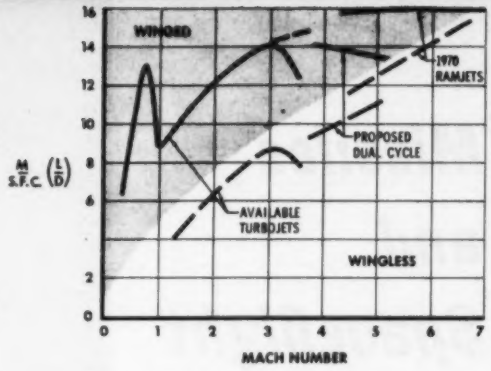


Fig. 5 (right). Range efficiency for varied types v. Mach number

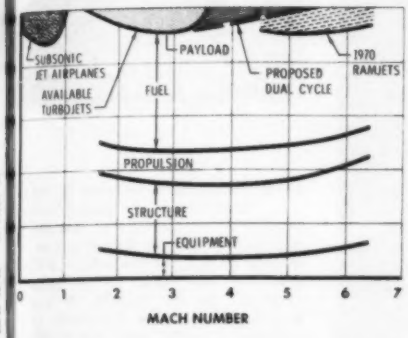


Fig. 6 (left). Weight distribution versus Mach number for a winged design with conventional take-off and a 3,500 n.m. range with reserves

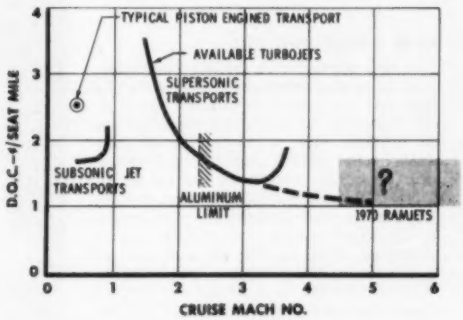


Fig. 7 (right). Direct operating cost v. Mach number, design as Fig. 6

required for a 3,500 nautical mile flight rapidly increased, with the result that a speed regime existed in which no payload could be carried. This highly inefficient flight regime extended from approximately 0.90 Mach to the Mach 1.5 region. Above Mach 1.5, it became possible to carry a payload again, and the magnitude of this payload steadily increased up to Mach 3.0. If dry turbojet engines of the type currently being tested were used for speeds above Mach 3.0, the payload capability again vanished.

As the flight speed had increased above Mach 3.5 it was necessary to make a transition from conventional turbojet engines to powerplants of the turbo-ramjet or pure ramjet type. This step represented a threshold in commercial aviation because of the introduction of a new philosophy—different propulsion modes for take-off, landing, and low Mach number operation as opposed to cruise operation. The outlook for carrying appreciable payload with dual-cycle powerplants of the type based on present state-of-the-art, and at speeds above Mach 3.5, showed promise, but was not yet sufficiently attractive to provide a firm basis for commercial operation in the immediate future. The longer range attractiveness of this higher Mach number region, however, was clearly indicated when 1970 ramjet performance was examined.

The results of this analysis could be crystallized in an economic sense by translating the payload capability (presented in Fig. 6) into direct operating cost estimates for commercial operation (Fig. 7). Present-day subsonic jet transport direct operating cost of the order of 1.75 cents per mile, for first-class operation at a range of 3,500 nautical miles, was a criterion against which to judge the attractiveness of future higher speed transport types. (The relative position of D.O.C. for today's piston-engined transports was worthy of note.) The D.O.C. estimate reflected the lack of desirability of flight at speeds between Mach 0.90 and 1.5. Indeed, it was improbable that an efficient supersonic transport aircraft would ever be designed to cruise in this area. The trend showed a steady decrease into the Mach 3.0 area, at which point direct operating costs were actually less than today's standards. As the conventional turbojet engine was improved for operation above Mach 3.0, this trend could be expected to continue to the limits of practical turbojet operation, perhaps in the vicinity of Mach 3.5. In the speed regime above Mach 3.5, using dual-cycle or ramjet propulsion systems, it had been deemed unwise to attempt a prediction of direct operating costs, because of the lack of data from propulsion development programmes, and because of the uncertain nature of cost estimates on improved materials and equipment. "Despite this lack of definitive information at the higher speeds," said Mr. Hibbard, "I predict that clearly attractive payload will be realized at speeds of Mach 5.0 or above, resulting in practical and economical operation."

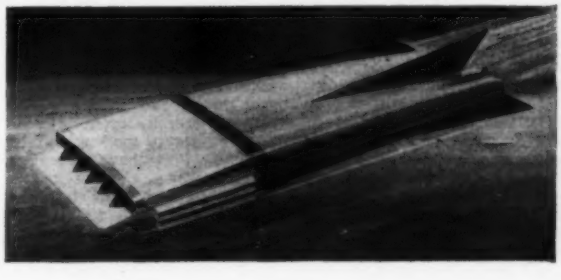
Inspection of the D.O.C. cost estimates in Fig. 7 revealed two areas of interest for the next step in long-range commercial aviation. These two areas were reflected by first, an airliner built to cruise just above Mach 2.0 at the limits of conventional aluminium structure; and second, one designed to cruise in the Mach 3.0 to 3.5 region with a steel and titanium airframe, and utilizing the full limits of conventional turbojet engines. Detail studies of the construction and development costs of aircraft design in each of these areas had been carried out. These studies had shown that, despite the increased construction and development costs of the Mach 3.0 airliner, its direct operating costs in cents per seat-mile were lower than those of the slower aircraft. Insignificant differences in take-off gross weight existed. The improved block speed and long-term growth-potential of the Mach 3.0 aircraft left little reason for further consideration of a design cruising speed less than Mach 3.0. Detail design and operational thinking on a supersonic transport of this type had been described in the lecturer's paper presented before the I.A.S. in June.

It was the lecturer's considered opinion that a transport cruising at speeds in the Mach 3.0 to 3.5 range would be the next step in commercial aviation. This transport (page 411) could be operational in 1965 if implemented.

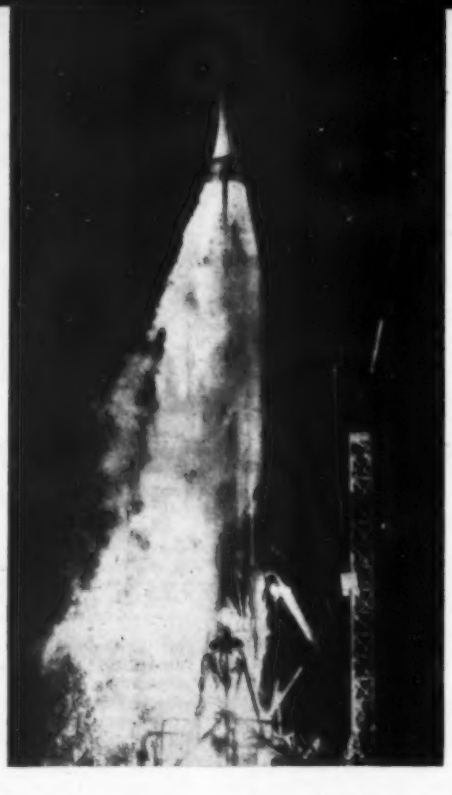
Developing further his prediction of a clearly attractive commercial transport potential at Mach numbers above 5.0, Mr. Hibbard pointed out some of the more interesting possibilities in this area. Design studies had been executed on both winged and wingless vertical take-off commercial transports having a cruising speed of Mach 6.0 to 7.0 and a range of 3,500 nautical miles. The results indicated that further research had to be accomplished in order to settle the question of winged or wingless vehicles, but the same information equally established that a wingless vehicle (Fig. 8) might, in fact, be practical and efficient for Mach 5 plus.

Therefore the development of future air transport—for example, the Mach 6.0-7.0 transport—might well have to be undertaken by industry without the advantage of military leadership. Mr. Hibbard was confident, however, that far-sighted thinking, in the tradition established by Dr. Plesman, would consider not only the existing trend toward rapid expansion of air traffic volume, but also the additional increase that would result from the vastly improved usefulness to the public of very-high-speed air transport: "This leads me to conclude that the world's commercial air carriers will have aircraft capable of cruising at Mach 6.0 to 7.0 in the foreseeable future and by foreseeable future I mean 30-40 years from now."

Fig. 8. A VTOL Mach 7 airliner. The nose section of the flattened all body configuration incorporates inlets for the primary ram jet propulsion system. The small fins are for stability and control. The ram jet air flow is diverted in ducts around the cabin



Missiles and Spaceflight



These photographs, released by the U.S. Department of Defense on October 8, are the first to show the operational type (Mk 3) nosecone developed by G.E. for the Atlas ICBM. Seen on the right before being mounted on the missile, it was launched from Cape Canaveral on October 6 (left) and flew 5,500 nautical miles down the Atlantic Missile Range

NEW CONES FOR OLD

The two photographs on this page illustrate what may prove to be the end to the long and chequered search by the U.S. Air Force for the optimum nosecone for its ICBMs. The original type of cone was a blunt (105 deg included angle) heat-sink assembly, which by virtue of its shape and construction provided protection for the warhead and instrumentation by shedding heat at a high rate and by absorbing what it could not shed. Using as a sink a slab of copper (produced by Wyman-Gordon as a closed-die forging 67.5in in diameter and weighing 1,375 lb), the cone was evolved by the Missile and Space Vehicle Department of General Electric. In its Mk 2 form it is standard on Thor and has been used on the majority of Atlases so far fired.

Heat-sink cones have grave disadvantages. They are heavy, and so substantially curtail the payload. Upon re-entry to the atmosphere they decelerate rapidly owing to their high drag. Moreover, their hypersonic behaviour is not ideal, and they leave behind a long trail of ionized gas which forms an excellent target for defensive radars. In contrast, the ablative type of cone, in which the outer layers actually melt and flow back from the tip, can provide protection without offering high drag. Pioneer work in this field was done by various agencies working for the Army Ballistic Missile Agency on a cone for Jupiter, and the final Jupiter cone—made by Goodyear—has a tip radius of some 12in and an included angle of only 27 deg. That this cone works was dramatically shown in May 1958, when the Army recovered the first full-scale cone ever to fly a full-range mission.

G.E. were accordingly awarded a further contract for an ablative-type cone for Atlas, and the first was flown, with complete success, on October 6. Compared with the Mk 2, it is claimed to permit greater accuracy, and is lighter, probably cheaper and re-enters at higher speed, thus greatly reducing the chance of detection or interception. It is some 10ft in height, but for most of its length has a very modest diameter. Bearing in mind the fact that the warhead probably has a yield of some 4 MT it is not immediately apparent how it has been accommodated, unless it is entirely in the flared skirt and conical re-entry body. The actual cone has a tip radius of some 5in and an included angle of 60 deg.

Preceding the flight of this semi-final cone, numerous Atlas missiles have worn the RVX-2 cone, also by G.E., which has a true conical form from the tip to the transition ring where it meets the top of the Atlas propellant tank. The first RVX-2 was successfully recovered from a full-range flight on July 20. It is likely that the final Atlas nosecone will bear close similarity to that which will be used by the new SM-80 Minuteman missile. The other U.S.A.F. ICBM, Titan, has a cone produced by Avco. All Titans so far tested have carried a blunt hemispherical assembly; but in all probability these have only been dummies, and the definitive Titan cone has yet to be flown.

LUNIK 3 PROGRESS

The implication of a complete circumnavigation of the Moon contained in the first announcements of the launching of Russia's "third cosmic rocket" on October 4 was quietly forgotten last week as the daily reports of the lunar probe's progress came in. What had been achieved, it transpired, was an extremely elongated orbit around the Earth during which the probe had passed within 4,350 miles of the Moon's surface, and had been deflected by lunar gravity into a position from which observation of the hidden face of the Moon would have been possible. This may have been what the Russians intended all along—"the rocket is moving strictly along the predetermined orbit" was a regular part of the daily reports—but it was certainly not quite what most scientific correspondents and observers in this country had taken as the meaning of "around the Moon."

Another misunderstanding was corrected during the week. The original statement that "the 183.6 Mc/s link will be used to control the elements of the orbit of the station," a claim which had aroused particular interest, was later corrected as "to check elements of the orbit." The main reports of the probe's progress were as follows.

On October 4 the first announcement of the launching had said: "The automatic interplanetary station will pass at a distance of about 10,000 km (6,200 miles) from the Moon, and after flying around the Moon will continue its movement to the area of the Earth . . ." This estimate of nearness to the Moon was amended the following day, October 5, when Tass reported that the probe would pass approximately 7,000 km (4,350 miles) from the Moon's surface at 2 p.m. G.M.T. on October 6 after a journey lasting 2½ days.

Also on October 5, visitors to Moscow Planetarium were told by the staff there that the orbit of the rocket represented an ellipse with a period of revolution of 9.5 days.

On October 6 Tass reported: "Having passed at 2.16 p.m. G.M.T. on October 6 the closest point to the Moon's surface (7,000 km away from it) the rocket continued to round the Moon. . . . The results of the preliminary processing of telemetric data during the second and third transmission periods show that the temperature on board is maintained within the range of 25-30 deg and pressure is about 1,000 mm of mercury, which corresponds to the required values. Scientific equipment, solar and chemical batteries are functioning perfectly." Earlier the same day the agency had announced: "It is thought that the station will move along a highly elongated orbit with the closest point to Earth at over 2,000 km (1,250 miles) and the farthest at 400,000 km (248,600 miles)."

At Manchester University's experimental station at Jodrell Bank, where the 250ft steerable radio telescope was being used to track the Russian probe, a break in transmission was noted between 2.11½ and 2.15½ p.m. Dr. J. G. Davies, deputizing for the director of the station, Prof. A. C. B. Lovell, said that it was possible that during those four minutes the rocket had "grazed past" the Moon at a distance, and was hidden by a narrow band at the edge of the Moon's disc.

Revised versions of orbital period and distances were given on October 7. "After passing the point of minimum distance from the Moon the automatic interplanetary station, circumventing the Moon, continues to move away from the Earth and the Moon. . . . In its further flight the station will continue moving away from the Earth and will reach the maximum distance of 470,000 km on October 10. Thereafter the station will begin moving towards the Earth and will pass by our planet on October 18, moving from north to south. The shortest distance from the Earth's surface will be about 40,000 km."

At the time of going to press it was not known whether the attempt to obtain photographs of the hidden side of the Moon from the probe had proved successful.

Missiles and Spaceflight . . .

THE NOVA ROCKET

THIS article is based on the paper "A Rocket for Manned Lunar Exploration" presented by M. W. Rosen and F. C. Schwenk of NASA at the recent congress of the International Astronautical Federation in London. It assumes that the simplest operational method is that of direct flight, using one large vehicle, rather than the orbital-rendezvous technique, and considers "a typical vehicle"—the five-stage Nova now under development by NASA—for a manned return trip to the Moon.

FIRST, we must define the mission. A two-and-a-half-day flight from Earth to Moon is chosen. The first three stages accelerate the payload and remaining stages to an inertial velocity of 36,000ft/sec. After coasting to the vicinity of the Moon, the fourth stage lowers the remainder of the vehicle to a lunar landing. At the time of departure, the fifth stage propels the vehicle toward the Earth. After two-and-a-half days, the payload approaches the Earth. Here there is a choice; a sixth stage of propulsion can be employed to slow the payload to orbital speed, or the vehicle can enter the Earth's atmosphere at hyperbolic velocity. We shall assume for the moment that hyperbolic re-entry can be tolerated.

One of the major concerns is the selection of propellants for the various stages. High-energy propellants, liquid oxygen and liquid hydrogen, are most desirable to achieve the mission with the least vehicle gross weight. Naturally, this propellant combination can only be used if the necessary engines are available and if the techniques for handling liquid hydrogen are developed. We believe that both these conditions can be met in the smaller stages. Consequently, high-energy propellants were chosen for the third and fourth stages of the vehicle.

For a return capsule weight of between 8,000 and 9,000 lb we can show that the vehicle at lift-off must weigh more than 4 million pounds. A sea-level thrust rating of over 6 million pounds is, therefore, a necessity. NASA is presently developing a rocket engine capable of producing 1½ million pounds of thrust with liquid oxygen and kerosine propellants. A cluster of several of these engines is therefore the logical choice for first-stage propulsion.

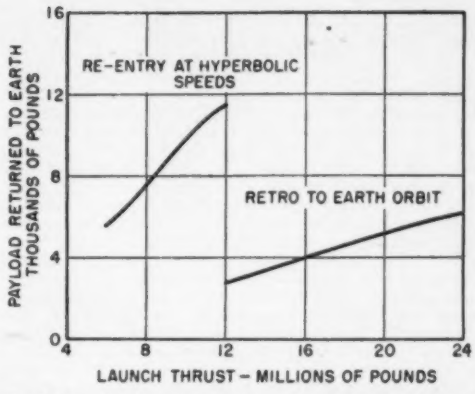
Now we must decide on the propellants for the second stage. The performance advantage afforded by the high-energy propellants is obvious—a 6 million pound thrust first stage with high-energy propellant in the second stage can provide the same payload capability as a vehicle having a take-off thrust of 9 million pounds and lox-kerosine in the second stage. However, calculations also show that a second-stage thrust level of 2.4 million pounds is required in the vehicle that uses the high-energy propellants. Such a thrust level in a high-energy engine may not be available for a long time. Hence, our choice at this time is a conventional lox-kerosine second stage using one engine.

Possibly, liquid hydrogen could be stored long enough on the surface of the Moon to allow its use for launching from the lunar surface. An impressive increase in payload (or reduction in first-stage thrust for the same payload) would be gained by employing high-energy propellants in the lunar launch. In this situation, the term "conventional propellants" refers to those that are liquids at normal temperatures and pressures, such as nitrogen-tetroxide and hydrazine. A fundamental question confronts us—Which propellants can be stored in the vehicle tanks on the Moon whose surface temperature varies, in the extreme, from −150 deg C to +134 deg C? There is a strong possibility that, with careful vehicle design and proper shielding against thermal radiation, high-energy propellants (liquid oxygen and liquid hydrogen) can be stored as well as any on the lunar environment. However, this is an area that has not yet been explored, and we chose at this time the more conservative propellant combination.

We have assumed that the return vehicle, or manned capsule, enters the atmosphere at hyperbolic velocities. Of course, a powered sixth stage could be employed to first slow the vehicle to orbital speed; thereupon the landing would be similar to that of NASA's Project Mercury. Fig. 1 shows what a retro-to-Earth orbit costs. For a capsule payload weighing 6,000 lb, 24 million pounds of thrust (16 engines) is required at launch if we must provide propulsion to place the capsule in orbit on the return trip. (Actually, a capsule weight of 8,000 pounds is desired.) Clearly, retro-to-orbit is a costly manœuvre and its use would require a vehicle so large as to make the task of a manned lunar landing too ponderous unless we considered nuclear or electrical propulsion schemes.

Weight Breakdown for Topical Direct Flight Vehicle

	lb		lb
Stage 1		**Stage 4** (landing rocket)	
Launch	6,700,000	Gross	102,000
Burn-out	2,000,000	Burn-out (on Moon) ...	49,100
Stage	5,000,000	Propulsion, tanks, landing gear	13,100
Stage 2		Payload on Moon	36,000
Gross	1,700,000		
Burn-out	678,000		
Stage	1,100,000	**Stage 5** (return rocket)	
Stage 3		Gross	36,000
Gross	600,000	Burn-out	13,700
Burn-out	146,000	Propulsion and tanks ...	3,800
Stage	498,000	Weight returned to Earth	8,000



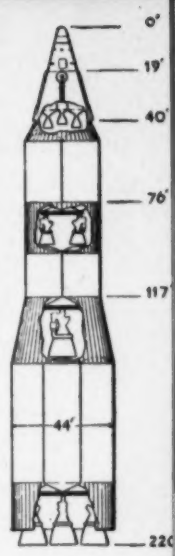


Fig. 1 (above). Effect of re-entry method on the variation of payload with launch thrust. Fig. 2 (right). General arrangement drawing of Nova direct-flight vehicle

Fig. 1, therefore, presents the reasons for assuming re-entry at hyperbolic velocity. It also emphasizes the need for research and development to provide this capability irrespective of direct or rendezvous approaches to a manned lunar mission.

Chapman of NASA has described the hyperbolic re-entry phenomena and corridors. He shows that the heating rates and heat absorbed are several times as great as in orbital decay of a non-lifting body, and that guidance requirements are severe as far as path angle accuracy is concerned. Chapman states that the tolerance on flight-path angle for proper entry into the atmosphere is approximately 1 minute of arc at distances of 10 to 100 Earth radii from the Earth. These are formidable problems, but considering how ballistic missile re-entry was solved once the problem could be stated, one expects that hyperbolic re-entry will yield to a similar treatment.

Typical Direct-flight Vehicle Characteristics. Fig. 2 shows a drawing of the typical direct-flight vehicle and the table (col. 1) presents vehicle weights. The vehicle stands about 220ft high and the first stage is 48ft in diameter. The conical portion at the top contains the landing or fourth stage, the take-off or fifth stage, and the manned capsule or payload. Upon return to Earth the payload will weigh 8,000 lb including men, equipment, capsule, guidance and control, and parachute. Two or three men will constitute the crew.

Six engines each of 1.5 million pounds of thrust power the first stage. Liquid oxygen and kerosine are carried in a cluster of seven tanks, each one 16ft in diameter. One altitude version of the 1.5 million-pound-thrust engine propels the second stage. This stage uses a cluster of four 16ft-diameter tanks. The high-energy third stage also consists of a cluster of four of these tanks and a thrust level of 600,000 lb is produced by four engines.

The fourth or landing stage utilizes high-energy propellants, and four throttleable engines provide the required variations of thrust for the landing manœuvre. The landing stage must have the capability for hovering to allow final choice of a landing spot by the pilot. Approximately one minute of manœuvring or hovering time is provided. Retracted landing legs appear on the side of the fourth stage. When extended for landing, the legs span a distance of 40ft for purposes of stability.

The fifth stage is placed in a cylindrical tube that pierces the tankage of the landing stage. At take-off from the Moon, the fifth stage slides out of the landing vehicle on rollers. We chose this arrangement because it presents a vehicle with a low centre of gravity which will reduce any tendency for the vehicle to topple on the surface of the Moon. In addition, the propellant tanks of the spent landing stage which surround the fifth stage serve as meteor bumpers and shielding against thermal radiation. Furthermore, no landing loads are transmitted through the return stage, thus minimizing the danger of a rough landing.

The manned capsule is an enlarged version of the one used in Project Mercury. It is a truncated cone, with a maximum diameter of 12ft and a height of 14ft. Inside the capsule, two levels are provided. The lower level contains contoured couches for the crew, controls, communications, and a folding air-lock for use on the Moon. The upper level contains food, power supply, exploration gear, and work space. The outer surface of the capsule is covered with ablative material for insulation against and removal of heat generated by atmospheric re-entry. (*Continued overleaf*)

Missiles and Spaceflight . . .

Guidance Systems. Guidance system requirements normally are divided into three phases: initial, mid-course and terminal. For this mission, we must provide these three functions for both the Moon-bound and the Earth-bound trips. In addition, we should consider the pilot's capabilities in performing major guidance tasks or in monitoring an automatic system. At present, the latter is most reasonable, since we believe that an unmanned return vehicle, a spare so to speak, should be placed on the Moon prior to the manned flights to provide an escape route should the manned vehicle be damaged upon landing.

The initial guidance phase from launch to Earth-escape can be accomplished with sufficient accuracy by inertial systems now under development. Mid-course guidance by means of Earth-based radio can direct the vehicle to an accuracy of 50 miles for a lunar impact trajectory. The terminal phase involves the final approach to the Moon and the lunar-landing. These manœuvres require vehicle-contained guidance; however, lunar-based radio beacons will assist. A combination radar-optical system will sense altitude and velocity components relative to the lunar surface. In all but the initial guidance phase (during launching), the pilot can effectively monitor and override the automatic system if necessary. During the mid-course phase, in particular, the pilot can make optical observations of the lunar disk for distance and path angle measurements. The pilot will also be very effective in the final phase of the landing on the Moon.

Launching from the surface of the Moon will be guided by an inertial system that is aligned and calibrated by the pilot on optical sightings of stars and Earth. The proper re-entry corridor in the atmosphere is reached by a combination of optical sightings from the vehicle and Earth-based radio signals. During re-entry, the lift of the capsule is utilized to modify the trajectory such that the vehicle follows a prescribed deceleration programme and lands within the recovery area. The first phase of the re-entry manœuvre will utilize vehicle-contained guidance monitored from the Earth. After the initial slow-down to orbital speeds, Earth-based radar in the landing area will control the vehicle.

NASA'S FIRST YEAR

"THE Congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind." Thus began the declaration of policy at the beginning of the National Aeronautics and Space Act of 1958, which went on to declare that aeronautical and space activities—except those "peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States"—should be the responsibility of a new civilian agency. This agency, the National Aeronautics and Space Administration, has just completed an extremely active first year of operation.

Eight main objectives for American aviation and space effort were listed in the Act establishing NASA, and among these were:

"The expansion of human knowledge of phenomena in the atmosphere and space,

"The improvement of the usefulness, performance, speed, safety and efficiency of aeronautical and space vehicles,

"The development and operation of vehicles capable of carrying instruments, equipment, supplies and living organisms through space, and

"The preservation of the rôle of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere."

Dr. T. Keith Glennan, president-on-leave of Case Institute of Technology, Cleveland, was appointed Administrator of the new agency, and on Wednesday, October 1, 1958, the Administration officially began to operate. It took over the functions and obligations of the 43-year-old National Advisory Committee for Aeronautics, together with NACA's staff of 7,966, its Washington headquarters and five laboratories and field stations. On the same date a number of Defense Department projects also were transferred to NASA—Project Vanguard, with 183 scientists and technologists from the U.S. Naval Research Laboratory; and, from the U.S.A.F. and A.R.P.A., five space probes, three satellite projects, and several engine research programmes including development of nuclear engines, fluorine engines and a massive 1.5 million-pound-thrust, single-chamber rocket engine.

In December 1958 the Jet Propulsion Laboratory, Los Angeles, operated under contract by California Institute of Technology with about 1,500 staff, was transferred to NASA from the Army. An agreement was also completed under which the Army Ballistic Missiles Agency at Huntsville would carry out assignments for NASA. Early in 1959 construction began on a new NASA research and development centre at Greenbelt, Maryland, which has been named the Goddard Spaceflight Center after the U.S. rocket pioneer Robert H. Goddard and should be ready for occupancy in mid-1960.

During NASA's first year the organization's space programme has included the launching of three space probes and three Earth satellites (not including the Explorer series sponsored by the Defense Department's Advanced Research Projects Agency); organization of Project Mercury; and initiation of a national space-vehicle programme to provide a family of new rocket engines.

On October 1 this year the number of personnel employed by NASA was 9,347. The Administration's budget for the fiscal year 1960 totals $500,575,000, including a 1959 supplementary appropriation of $38.5m. The current budget includes $335m for research and development (most of which goes directly into industry and university research contracts), $91.4m for salaries and expenses and $73.8m for construction and equipment. Plant investment is estimated at more than $400m, including the ex-NACA facilities at Ames Research Center, Edwards, Langley Research Center, Lewis Research Center and Wallops Island.

Project Mercury, NASA's man-in-space programme, was initiated on October 5, 1958. The seven potential astronauts were selected in April 1959 and, as reported last week and illustrated here, the first firing of a Little Joe booster with full-scale boilerplate Mercury capsule model took place on October 4. Little Joe comprises four XM-19 Recruits and four XM-33 solid-propellant rockets (together giving 250,000 lb or 360,000 lb thrust depending on the type of XM-33), plus four M-58 Falcons for separation of capsule from booster. Assembly of Little Joes is by North American Aviation

---

Adhering to their one-a-month schedule, R.A.F. Bomber Command have fired their sixth Thor IRBM from Vandenberg A.F.B. The firing, watched on October 6 by Lord and Lady Mountbatten, achieved all test objectives, although it was conducted under simulated operational conditions to achieve minimum reaction time.

Further discoveries claimed for the Soviet lunar probe which scored a direct hit on September 13, in addition to the fact that the Moon has no magnetic field, are that it has no noticeable surrounding radiation belt, and that "some kind of traces of ionosphere" are present 10,000 km from the lunar surface. The "radio-electronic lunar altimeter" carried by the probe was stated in an article in *Pravda* to have "sent signals to the Moon, picked up the echoes and sent them to Earth, making it possible to measure automatically the distance to the surface of the Moon on the last stage of the rocket's flight."

Construction of H.M.S. *Kent*, the third of the Royal Navy's guided-missile ships which are being armed with Seaslug, is due to start in November at the Belfast yards of Harland and Wolff Ltd.

A research facility possessing test chambers able to reproduce the extreme vacuum encountered at orbit altitudes of more than 400 miles is now being operated by National Research Corporation of Cambridge, Massachusetts. Largest of the test chambers is 45 cu ft in volume.

Allison Division of General Motors are promoting an external combustion engine operating on the Stirling cycle for use wherever a self-contained source of power is required to operate for extended periods (as may be the case in spacecraft).

It was announced in Paris on September 28 that the French Army has now formed the first battalion equipped with Nike (presumably Nike Ajax) surface-to-air missiles. The unit "will be operational very soon" and will be stationed in Western Germany, attached to the 1er Catac (Tactical Air Command) of NATO.

It was disclosed last month by Hamilton Standard that they are in receipt of a contract for a spin motor to stabilize the Little John (U.S. Army artillery rocket) until flight speed is sufficient for the fins to become effective. It can now be stated that Little John can carry an atomic warhead, although it is but 12ft in length and 12in in diameter. A Phase 2 version is under development.

. . . . DEADLIER THAN THE MALE

The high contrail seems to be forming a question mark; but there is no question that in Fleet Air Arm annals the Sea Vixen (de Havilland, 1959) is deadlier than the Seafox (Fairey, 1936). For the latter was the dainty twin-float reconnaissance seaplane that won its fame at the Battle of the Plate; whereas the 'Vixen is a burly twin-jet all-weather fighter bristling with ordnance—notably de Havilland Propellers Firestreak missiles

"Flight" photographs

THE ANGLO-AMERICAN CONFERENCE

Presentation of the Sperry Award to de Havilland: Sir Aubrey Burke's Address

Sir Aubrey Burke, whose Conference lecture on the D.H. Comet is reproduced in these pages

ON the evening of October 7 a New York City television station presented a filmed short subject entitled *The Battle of Britain*. Whether by accident or design, it was particularly appropriate that the screening occurred concurrently with the presentation in New York of the Elmer A. Sperry Award to representatives of the de Havilland Aircraft Company. Gathered in the Grand Ballroom of the Astor Hotel on that Wednesday evening were more than 500 scientists and engineers of Great Britain, Canada and the United States who had attended the technical sessions of the Seventh Anglo-American Aeronautical Conference.

Seated on the dais were the guest of honour, Mr. Peter G. Masefield, president of the Royal Aeronautical Society, and distinguished representatives of the three participating nations. Hanging directly above the centre of the main table was a tattered and torn, smoke-stained Union Jack. As Mr. William Littlewood, president of the Institute of the Aeronautical Sciences, explained to the audience, the flag had flown over the R.Ae.S. offices in London during the Battle of Britain and for most of the Second World War. It had been presented to the I.A.S. in 1944 as a symbol of friendship, and had remained a "treasured memento" in the archives of the Institute. It served as a continual reminder, said Mr. Littlewood, of the debt owed to a country which had served as the bulwark behind which America prepared herself for entry into the great conflict.

The Sperry Award is intended "to commemorate the life and achievements of Elmer Ambrose Sperry, whose genius and perseverance have contributed so much to all types of transportation." First presented in 1955 (on the 25th anniversary of the death of Mr. Sperry), it is made annually in recognition of achievement "which through application, proved in actual service, has advanced the art of transportation, whether by land, sea or air." The citation which accompanied this year's award stated:—

"The Elmer A. Sperry Award for 1959 is made to the de Havilland Aircraft Company Ltd. for the vision, courage, and skills displayed in conceiving, developing and producing the world's first jet-powered passenger transport aircraft, the de Havilland Comet, powered by de Havilland Ghost jet engines.

"This accomplishment is especially noteworthy as providing the example and inspiration which has brought into being the succession of efficient, high-performance, subsonic jet transports that have followed under various leaderships throughout the world.

"The Award is made to Sir Geoffrey de Havilland as President and inspired leader of the Company that bears his name; to Mr. C. C. Walker, the Company's then Technical Director and Chief Engineer; and, In Memorium, to the late Major Frank B. Halford, then Chairman and Technical Director of the de Havilland Engine Company.

"A Certificate of Citation is likewise awarded to the co-workers for their contributions in this pioneering venture."

Mr. Littlewood expressed the pleasure of the Institute in being able to "do honour to one of the truly great contributors" in the aircraft industry. He then turned the speaker's platform over to Mr. Masefield, whose witty comments brought frequent laughter. In a more serious vein the guest of honour gave thanks for the hospitality offered by the I.A.S. Among the by-products of the conference, he said, were the real friendships which were made, and he hoped that now it would be possible to go "hand in hand into astronautics." He looked forward to the R.Ae.S. holding the eighth Anglo-American Conference in England in 1961.

Dr. T. P. Wright, past president of the I.A.S., then arose to speak briefly and to make the presentation of the awards. He recalled that he first had met the three principally named in the Sperry Award (Sir Geoffrey de Havilland, Mr. Walker and Major Halford) on July 14, 1934. The occasion was the King's Cup Race, and it was on July 15 that Dr. Wright inspected the two models of the original D.H. Comet which were to subsequently capture first and fourth places in the McRobertson Race to Australia. It was fitting, he thought, that second and third places in that race were taken by products of two companies who were still so prominent in the transport field; second place had been taken by a DC-3 of K.L.M.'s fleet, while third went to a Boeing 247. The long successful line of de Havilland aircraft were also briefly reviewed by the speaker, who then presented the Sperry Award. It was accepted on behalf of Mr. C. C. Walker, whose ill-health prevented his attending the conference, by Dr. E. S. Moult, technical director of the de Havilland Engine Co., and president-elect of the R.Ae.S. A second award was presented to "Pat" Halford (Mrs. John Draper) as a tribute to her father, the late Major Frank B. Halford, who conceived the Ghost turbojet and so many other fine aircraft engines. Major Halford's enthusiasm and vigour were given particular praise by Dr. Moult. The third Sperry award, given to the technical associates and co-workers at de Havilland for their contributions to the Comet programme, was received by Mr. Ian Fosset, who represents D.H. interests in America. The final award, to Sir Geoffrey de Havilland, was accepted by Sir Aubrey Burke, chairman and managing director of the de Havilland Aircraft Co. Sir Aubrey read a note from Sir Geoffrey, who expressed his "profound apologies" at being too ill to attend the conference. The Comet had been, said Sir Geoffrey, "our most inspiring and challenging project," and of the many awards his company had received, none had given him more pleasure than this one. Sir Aubrey spoke briefly of each of the persons that the Institute was honouring at that time, and then went on to deliver the principal address of the evening, *The Comet* (given almost in full below).

The address by Sir Aubrey completed the evening's formal activities. On the following morning the British party broke into two parts to make separate tours of various U.S. facilities. After four days of visits, which were to encompass trips to the West Coast of America, the parties were reuniting in Toronto for several days of meetings and tours arranged by the Canadian Aeronautical Institute. A final meeting was scheduled for today, October 16.

THE COMET

Sir Aubrey Burke's Address

SIR AUBREY BURKE began his address by recalling that the Comet's real origin went back to 1943, the year in which the first jet engine and aircraft to be built by de Havilland started flight trials. The aircraft, the Vampire fighter with the Goblin engine, exceeded 500 m.p.h. by a handsome margin; and although as a fighter its high speed was its outstanding characteristic, it had other qualities which seemed to offer attractive prospects in wider fields.

The test pilot who made the first flights in the Vampire, Sir Geoffrey de Havilland's eldest son, was impressed by the lack of vibration and the quietness in the cockpit, which he compared to a glider. Frank Halford, with some thirty years of piston-engine experience behind him, was encouraged by the simplicity and the reliability exhibited by his first engine, while Sir Geoffrey de Havilland and Charles Walker, always glad to turn their thoughts to civilian aircraft, were quick to appreciate the advantages which these qualities might bestow on the airliner of the future.

In these mid-war years the jet engine was being hailed as the future powerplant for military aircraft—by any previous standards its power for a given weight was enormous and it clearly offered prospects of flying speeds far in excess of those of the past. But in 1943 such high speeds were still linked, in most people's minds, with fighting aircraft only.

The most impressive feature of the jet engine was, of course, its power. Hardly less impressive in those days was the high fuel consumption, a characteristic which caused the commercial possibilities of the turbine to be dismissed almost universally without more ado. But Sir Geoffrey and Charles Walker, with their traditional leaning towards civil aviation, found time to discuss the pros and cons of the jet airliner. Rough calculations were not discouraging and further study seemed justified. The aerodynamicists were asked to make more detailed investigations in the light of their experience with the Goblin-Vampire combination.

A potent factor in these early thoughts was the disadvantageous position in which the British aircraft industry would find itself in the manufacture of transport aircraft at the end of the war. In the early days of the war, when the first priority was to beat off the enemy, Britain had no choice but to concentrate her energies on fighter aircraft, at first even at the expense of her bomber force, and at no time during the war could any part of her production capacity be spared for transport aircraft. By agreement we looked to the United States. How well these needs were met by, for example, the versatile DC-3 was another story, to which due tribute had already been rightly paid by the donors of the Elmer Sperry Award.

The de Havilland team studying the possibilities of the jet airliner were well aware of the handicap which this wartime policy would impose on the British aircraft industry in the bid for a share of the post-war airliner market. It was clear that it would be difficult, with a conventional aircraft, to match the well-

developed transports already in production in the United States; to produce something better in time to compete would be a near impossibility. In this context the jet engine seemed to offer a chance for Britain to gain a commanding lead.

With this attractive possibility in view the exploratory work at Hatfield continued and a reasonably hopeful picture began to emerge. It was becoming evident that the jet airliner could be made commercially competitive because the high cost of fuel would be partly offset by the low weight of the engine and by the high speed which the aircraft could achieve with jet power at high altitudes. In other words, the high speed of the jet aircraft resulted in a reasonable fuel consumption reckoned in terms of miles per gallon, although the figure for gallons per hour was high. The attraction of jet travel—its quietness and lack of vibration—was an additional bonus, whilst the speed had its commercial value in that it almost doubled the work capacity of the aircraft when reckoned in terms of ton-miles per annum.

"These factors are, of course, now widely appreciated and proved in practice," said Sir Aubrey, "but I imagine that in 1944 there were few outside the de Havilland team who gave them more than a passing thought."

Many would remember the Brabazon Committee, of which Lord Brabazon was chairman and Sir Geoffrey a member, which was convened in London in 1943 and sat during the closing years of the war. Its brief was to study and make recommendations regarding the types of civil aircraft on which the British aircraft industry should concentrate after the war. One of the eight types recommended, the Brabazon 4, was a jet transport.

As the investigation went deeper so the enthusiasm grew; and, as the end of the war approached, the decision was made to go ahead and design a jet transport. All that was needed was an order. For some time the two British airlines then operating long-distance routes, British Overseas Airways Corporation and British South American Airways had been studying the de Havilland proposals and eventually these airlines placed orders for eight and six aircraft respectively. In addition, the British Ministry of Supply ordered two aircraft.

Project becomes Reality

So the project progressed from generalized calculations to specific layouts. Many different forms were investigated, ranging from a twin-boomed arrangement similar to the Vampire but with three Goblin engines, to a tail-first configuration with three rear-mounted engines; the first application of an engine installation now adopted by the second generation of jetliners such as the D.H.121. Serious consideration was also given to a flying-wing version with no tail, and a scaled-down model of this shape was built around a Vampire fuselage. This aircraft was known as the D.H.108, and three were built. It would be remembered that it was in one of these aircraft that Sir Geoffrey's son, then the company's chief test pilot, lost his life in September 1946, while flying at a speed greater than had hitherto been achieved anywhere. He was carrying out trials prior to an attack on the world speed record.

Later the D.H.108 became the first British aircraft to exceed the speed of sound, but although it proved that the aerodynamic efficiency of the tailless formula was good, control at high speed was inadequate and it was also clear that, in a tailless jetliner, the landing weight for a given landing speed would have been uneconomical mainly because ailerons had to serve as elevators ("elevons") and reduced the lift of the wing when landing. It was therefore decided, during September 1946, that with the knowledge then available the tailless layout was not suitable for a passenger aircraft. Finally it was decided to concentrate on a design which was conventional within the limits of the new technique, and the outline of the Comet began to emerge. This decision was partly dictated by the fact that time would not allow the building of an experimental prototype—the new aircraft must necessarily go straight into production off the drawing board if the post-war demand was to be met promptly and the hoped-for British lead was to be established.

Frank Halford, then technical director of the de Havilland Engine Company, took part in all the jet airliner discussions from the earliest days and his enthusiasm for the project rivalled that of his colleagues in the Aircraft Company. His association with Geoffrey de Havilland dated back to the days of the First World War, when de Havilland and Halford worked together to fit Halford's B.H.P. engine into the early D.H.4 biplane bomber, and there had grown up between the two men a close understanding. From the first they seemed to have appreciated the necessity for the closest collaboration between aircraft and engine designers. In 1924 the same trend was evident in Halford's production of the original 60 h.p. Cirrus (made up of parts from a war-surplus engine) to suit de Havilland's requirements for the light aircraft which became the Moth. Another much publicized example was the Comet racer of 1934, with two special Halford-designed Gipsy engines, designed and built in nine months to win the England - Australia race.

Halford's approach to the gas turbine engine was characteristically energetic. Working during the blitz of 1940-41 against the background of Whittle's great pioneering work, he was able to visualize a somewhat different conception of jet engine—one having a single-sided impeller used with straight-through combustion. These features were decided upon in April 1941, and they were retained in the Goblin engine for the Vampire and in the subsequent Ghost engine which powered the first Comet.

The Ghost engine, an enlarged version of the Goblin, was developed primarily for use in fighter aircraft (it is still in service with the Royal Navy and the Royal Air Force), but with its 5,000 lb of static thrust it was just what was needed at that time for the jet airliner. The Ghost first ran on the test bed in September 1945, and a civil version for the Comet was given high priority.

The axial-compressor type of jet engine is now established as a satisfactory powerplant for civil operation, but at the time when the Comet design was being finalized there were many advantages in using the well-tried centrifugal type. By then the axial-compressor type of engine already held out a promise of higher compression ratios and better specific fuel consumption, but the new type was still relatively unknown and the problems of the axial compressor, with its critical surge and stall characteristics, had not then been solved. Furthermore, the extreme robustness of the centrifugal compressor had great attractions. For these reasons there was no hesitation in choosing the Ghost engine for the Comet and in retrospect it is clear that this decision was right; it was the Ghost engine which made possible the Comet's early entry into service.

Although in its essentials the Comet was a fairly conventional aircraft its design inevitably introduced many new problems associated with such features as power-operated controls and the use of a cabin-pressure differential of 8¼ lb/sq in—double the pressure in general use at the time. The new problems called for an intensive programme of practical experimental work, which continued during the design and early production stages. Having completed its aerodynamic programme the D.H.108 tailless aircraft was used for developing the Comet's power-operated control

(*Concluded on page* 416)

Photography in Aircraft Development

(Right) Instrumentation photography during Vanguard flight-testing. The 35 mm camera with 200ft magazine is used in conjunction with four Hussenot recorders. (Left) Britannia flight-test observer using a hand-held cine camera

MOST airline passengers are well aware of the vast amount of research which precedes the emergence of a workable transport aeroplane. Flight testing, static structural investigations and wind-tunnel research are all relatively familiar; but what is less well known is the importance of the many parts played during such programmes by the versatile camera.

Reproduced here are illustrations which portray four of the many rôles played by photography during the development of modern airliners. Not only is photography essential in the course of flight testing, but during static tests on models and various types of rig, cameras must be employed to record data—sometimes to capture behaviour of an exceedingly transient nature—and also to maintain a record of design improvements incorporated in tunnel models. The latter may be coated with oil or provided with arrays of wool tufts in order to render visible even minute changes in shock formation and airflow.

For example, one picture shows the testing of a 1/36th-scale Viscount model in one of the Weybridge tunnels. The wings have been covered with oil and the conditions simulated represent a Mach number of 0.74, or 560 m.p.h. This, of course, is much faster than the Viscount would operate in service, and indicates the large safety margin that is allowed in every test. The thick band of oil running spanwise at about 0.25 chord shows the shock-wave position. Also clearly visible is the oil flowing forward from the trailing edge, which indicates that shock-induced separation is present.

The companion picture is also in the wind tunnel, but this time the model is to a scale of 1/15th, the angle of attack is greater, the speed is around 250 m.p.h. and the wings are covered with wool tufts to show the airflow. Disturbance is particularly noticeable over the outer wing.

An interesting structural test is to determine crack-propagation rates, and a Viscount front fuselage was placed in a special chamber where conditions were simulated to fluctuate between sea level and 25,000ft at a temperature of −30 deg C. Once again the conditions were intensified as a safety margin. A javelin was fired at the fuselage to cause a puncture of the skin, and the crack filmed every few days to show its growth and final extent.

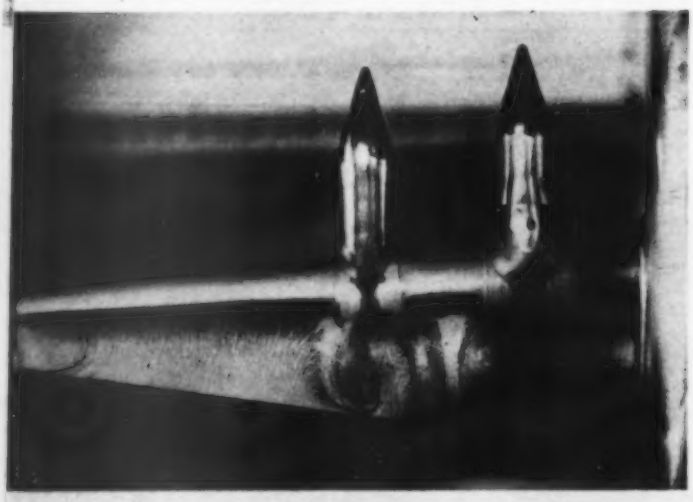
Even when an aeroplane has flown, photographic records continue to be made. These checks are so numerous that the entire fuselage and cockpit may be filled with panels of meters and gauges from which automatic cameras make continuous film records. One of the photographs above shows a 35 mm cine camera with a 200ft magazine operated in conjunction with four Hussenot recorders, each loaded with 60 mm R.P.35 recording paper. This is only one of many such panels that were installed in the Vanguard.

The same type of airborne research was applicable to the Britannia and one particular problem was solved specifically by film. This involved modifications to the landing gear, which necessitated knowing exactly how the undercarriage behaved during take-off and landing. A Bolex H16 cine camera was attached to a special panel on the belly of the Britannia and coupled to an electric motor. It would have been impossible to procure this information by any other means.

When all its teething troubles have been ironed out and an aeroplane is at last a commercial success, then the industry's use of film is just getting into its stride. At Vickers' Weybridge works, a service training school uses film to instruct air and ground crews in the servicing of aircraft. Publicity is another major aspect, and news "shorts" are produced for television and cinema newsreels. *The Whispering Giant*—the story of the Britannia—has been shown on television more than once and was filmed by G. L. Weinbren, films officer for Bristol Aircraft. Colour documentaries are also made, and Bristol Aircraft are particularly active in this field.

It would obviously take many pages to cover every aspect of aircraft-industry photography, which includes radiography for determining (to quote but two examples) wiring and metal-structure faults.

D. T.



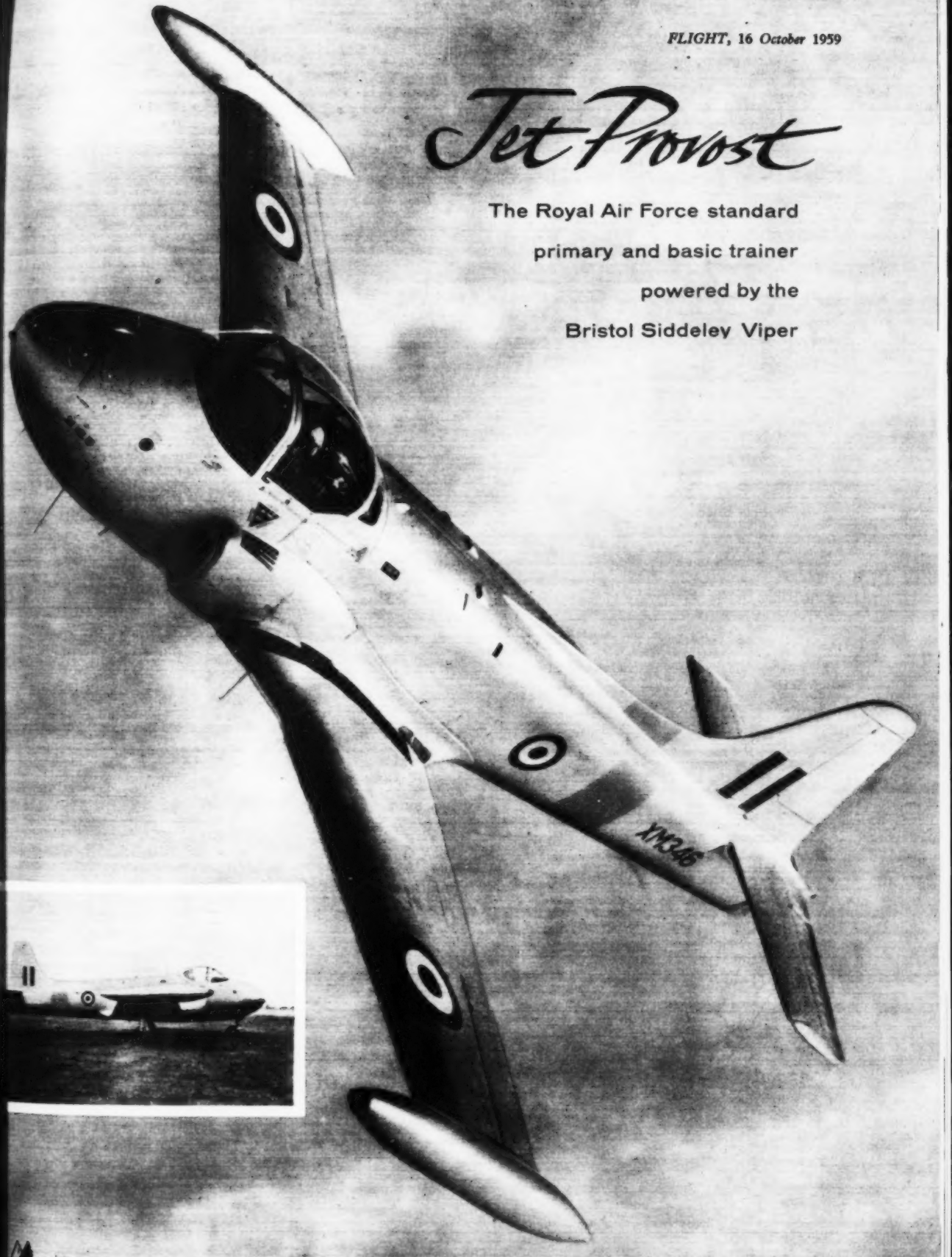
(Left) Wind-tunnel testing of Viscount wing models using oil and (lower left) wool-tuft techniques for indicating airflow. (Below) Full-scale wool tufting as seen in an air-to-air photograph

ANNOUNCEMENT

X

Jet Provost

The Royal Air Force standard
primary and basic trainer
powered by the
Bristol Siddeley Viper



HUNTING AIRCRAFT LIMITED

A Hunting Group Company

LUTON AIRPORT, LUTON, BEDFORDSHIRE, ENGLAND and at 1450, O'CONNOR DRIVE, TORONTO, CANADA.

She's all yours!

'This is it! Solo for the first time. Start with cockpit checks — instruments, oil pressure, take-off trim. Good. Brakes off . . . a quick look round . . . full throttle.'

'Keep her straight. Ah — not so bumpy, nose wheel is off the ground. Faster . . . faster . . . gently back with the stick . . . up and away in a steady climb.'

Today's pilot starts on jets!

You could be in a Jet Provost learning to fly within a few months of getting your R.A.F. uniform. Quick progress, and so it goes on. Once you are qualified, the world is your parish. Flying is your profession, but you will add to it experience and increasing authority. A career in the R.A.F. blends adventure with high responsibility.

A full life . . . in the Royal Air Force

Could you make the grade as an R.A.F. aircrew officer? For details of how to apply, of pay*, conditions and allowances, write to the Air Ministry, M.9., FR28a, Adastral House, London, W.C.1. (Applicants must be between 17½ and 26 and have gained a good G.C.E. or equivalent.)

**A Flight Lieutenant of 26 can earn, with full allowances, nearly £1,700 a year.*

Three types of commission: (1) Permanent, leading to a pension. (2) 12 years, with the option to leave after 8 years, and the chance of gaining a permanent commission. (3) 5 years, also with the chance of gaining a permanent commission.

'Steady though; we've still got to land . . . Down undercarriage . . . Down flaps . . . This is living! This is why I wanted to join the R.A.F.'

'Not bad . . . not bad at all. A little wide on the approach, but a smooth enough touch-down. And my best take-off yet. Hope my instructor was watching.'

Rotary Quadrille

FLIGHTS IN FOUR AMERICAN HELICOPTERS

DURING recent demonstrations four American helicopters made their European debuts, and the writer of these notes was able briefly to sample all four of them in the air. Greatest in capacity, the Vertol 107 impressed with the vibration-free comfort afforded by the twin rear-mounted Lycoming T53 shaft-turbines* driving a pair of three-blade rotors overlapped in tandem. This smoothness was particularly apparent from well forward in the fuselage—which, for demonstration purposes, was divided into a front compartment furnished for eight passengers, and a rear section showing the disposition of litters for military casualties. Although much faster (128 kt cruise) and some 8ft shorter than the Vertol 44 (civil version of the familiar H-21, powered by a Cyclone piston engine) the model 107 actually has a 50 per cent larger cabin capable of seating 25 passengers, and in freight-carrying guise the loading of cargo is facilitated by a retractable rear ramp. Such a ramp will be an important feature of the U.S. Army's YHC-1B Chinook, an enlarged and developed version (twin Lycoming T55s) intended for transporting a maximum of 40 troops. Although the continuous-section fuselage is sealed for amphibious operations the 107 did not disport itself in an artificial pond at Le Bourget, as did the Sikorsky S-62; but Vertol point out that, having tandem rotors, it can accomplish an autorotative landing without flare-out, at any fuselage attitude.

Carrying rather less than the Vertol, and having only one T58 turbine, the S-62 makes use of the entire rotor system of the well-proved S-55; and, with its boat-hull and outrigger floats, it exhibits truly nautical manœuvrability on water. Passengers were embarked on land and, after a leisurely circuit the S-62 was put gently down on a specially-constructed pool from which disembarkation was made, thus effectively demonstrating the versatility of the design. This machine was equipped with lengthwise webbing seats, and, lacking the soundproofing and upholstery of the airline version, was noticeably less quiet than the Vertol. As is the case with the Vertol 107, the S-62 is undergoing "growth" development, and a mock-up of the larger S-61 was on display. Eighteen feet longer than the S-62, the S-61 has about double the capacity (25 seats) and thus approximates to the Vertol. Either two or three T58s power the S-61, driving a five-blade main rotor and a six-blade tail rotor.

At first glance, the Bell HU-1 Iroquois may appear to be only a slightly enlarged version of the familiar four-seat Model 47; but on closer acquaintance the 8ft-wide cabin is found to have accommodation for no fewer than ten persons. Aft of the well-spaced pilots' seats are three individual passenger seats, and aft again is a full-width bench seat for a further five. The single Lycoming T53 shaft-turbine is mounted above and behind the cabin, driving a two-blade bar-stabilized main rotor and a two-blade tail rotor, as is customary on Bell designs. In flight, manœuvrability was shown to be very lively with eight people up, visibility through the many large windows was excellent, and the noise-level very low indeed for a purely military design. Cargo may be carried both internally and externally, and the large sliding doors and wide cabin facilitate the loading of four stretcher-patients.

Looking forward along the 8ft-wide cabin of the Bell HU-1

Following tests of three prototypes and 15 trial machines, production orders for 157 are currently in hand for the U.S. Army.

Smallest of this quartet is the Doman LZ-5—which, despite the markedly obsolescent nature of piston engines for contemporary helicopters, has many features to commend it to operators. Perhaps the most attractive of these is the totally-enclosed self-lubricating rotor hub, mounting the four hingeless blades; control is effected by tilting the gimbal-mounted rotor-head. The six passengers occupy seats angled out towards the sizeable windows, and with seats removed the concertina doors on each side fold to give a completely unrestricted access for large items of cargo. The eight-cylinder Lycoming engine is inclined low in the nose, and drives via a shaft passing between the pilots up to the rotor-head. Exhaust-ejector cooling obviates the necessity for engine-driven fans and thus increases net rotor power. In the air the LZ-5 demonstrated great tractability, with sufficient reserve from an engine of only 400 h.p. Ground resonance was quite absent, and vibration in flight not excessive for a craft of this type. D.I.P.

**The General Electric T58 is the production powerplant.*

The Sikorsky S-62 (right) is powered by a G.E.C. T58 turbine offset to port. (Below) The six-passenger Doman LZ-5; and the Vertol 107, which can seat 25

"Flight" photographs

LIVING HIGH

By N. J. CAPPER

WITH A TWIN PIONEER ROUND THE ELEVATED-ALTITUDE AIRPORTS OF SOUTH AMERICA

LA PAZ, capital city of Bolivia and the highest capital in the world, is over 12,000ft above sea level. Its nearest airport, El Alto, is just over 13,400ft and is the highest commercial airport in the world.

During a tour of South America in a Scottish Aviation Twin Pioneer I was fortunate enough to have an opportunity to visit La Paz. With a crew of three—co-pilot and two engineers—I had flown many hundreds of miles over the Caribbean waters and islands and over the jungles of the Guianas; interesting and often formidable enough, but nothing to the craggy "moon country" and tremendous altitudes of the Andes. To climb up to 17,000ft or so is fairly commonplace even in a piston-engined aircraft; but virtually to stay up there for a landing is, to say the least of it, a novel experience.

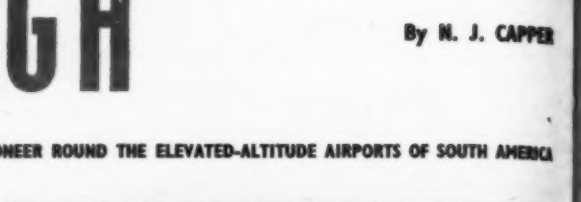
We carried sufficient spares and equipment for a trip of five-and-a-half months and on our way through Colombia and Equador we had encountered some of the problems which confront the aviator in this part of the world. Bogota, capital of Colombia, is more than 9,000ft up and Quito, capital of Equador, is still higher. We had also seen why the aeroplane is accepted as the only practical means of transport for passengers and most of the freight. What railways there are look fairly primitive and wind their way up into the mountains by very tortuous routes. Good roads are far too expensive to build.

The airfields that serve these high-altitude cities lie in natural basins, and (it doesn't seem to matter how high you go) there are always mountains towering above. Pilots get to know the weather and the terrain and how to find their way through gaps and over ridges to the flat ground where the airfield lies. It was all very new to us, but there was a wealth of good advice available and a fairly comprehensive radio beacon service. Nevertheless, it is quite alarming to be confronted by what appears to be a wall of massive rock with the altimeter showing 10,000ft or so and broken cloud all around. The best way to avoid the daily build-up of cumulus and cumulo-nimbus cloud is to get your flying done before noon, but this is not always easy to arrange. Fortunately, the weather is generally good; the bad spells, caused by tropical fronts, are usually of short duration.

Our trip to La Paz was made from Lima in Peru, with a refuelling stop at Arequipa, an attractive-looking city 9,000ft up, though quite near the coast and reputed to have 360 days of sunshine a year. We had some 600 miles to do from Lima so, although we got out of bed pretty early, it meant a late-afternoon arrival at La Paz.

After clearing Customs and Immigration at Lima we climbed through a layer of strato-cumulus into brilliant sunshine and flew south along an arid coastline broken occasionally by a dried-up river bed. The cloud at Lima had formed a few days before we left and we were told it was liable to persist for some months, having a rather gloomy effect on an otherwise delightful climate with the temperature in the high seventies. About 50 miles south, however, the cloud dispersed and we had bright sunshine all the way to Arequipa.

Here we stopped for fuel and a sandwich lunch. Away to the east we could see ominous signs of cu-nim clouds building up. They were partly obscured by the mountains and only the white



The Twin Pioneer at El Alto Airport, La Paz

tops were showing. We took the sound and helpful advice of the air traffic control officer and decided to follow what he called the light-aeroplane route. This meant another 50 miles or so, but a sprinkling of emergency airstrips on the way.

After take-off we climbed steeply to 17,000ft until we could see a gap between the peaks; but when we were through it we still had to stay at 15,000 or 16,000ft to keep above the ground. We had discussed the question of carrying a supply of oxygen, but there were many problems and we decided to manage without and to keep an eye on each other for signs of anoxia. In any case, we were going to have to live—and work—at over 12,000ft for a few days.

As we flew along at about 1,000ft above the ground we saw the emergency strips. There was not much sign of civilized comfort and I am sure we were glad we didn't have to stay the night at any of them; but, no doubt, in an emergency we would have overlooked the bleakness.

On the east side of the mountains we encountered heavy cloud and then violent thunderstorms; no worse than the kind of thing you get near Manchester or Birmingham on a summer's afternoon, but somehow the altimeter made the whole thing a bit eerie. The A.D.F. had been tuned to the La Paz beacon but it was showing a preference for the most influential storm. There was some spectacular forked lightning all around and (as we discovered later) the static was sufficient to pepper the wing-tips with small holes.

We were able to follow a railway line for a time and eventually the radio compass decided in favour of La Paz beacon. We emerged over an enormous plateau, the Altiplano, with El Alto airfield in the distance. Our route guide had warned us to look out for llamas and Indians straying on the runway; but, seeing neither, we did two landings just to try out the performance of the aircraft. It was very little different, the increase in ground speed seeming insignificant and no special allowances being necessary. For take-off we could get only minus half a pound of boost instead of plus eight, but the run was only about three times that at sea level. The climb-away was another matter; we were, however, far better off than the others, as we saw during the next few days. The main runway is 3,700ft long, gravel-surfaced and with a two-degree gradient sloping down to the west. There is a fairly constant

Llamas are sometimes a landing hazard at La Paz

six-knot wind from the east, so take-offs are nearly always made downhill and down wind. Twin- and four-engined airliners used the whole length of the runway and disappeared for some minutes after take-off, only to reappear about ten miles away, barely gaining height. The Twin Pioneer used only about 400 yd and was climbing well before the end of the runway was reached. The rate of climb was very much less than we were accustomed to, but it was enough to impress those used to these conditions.

On arrival, we learned that, as it was May Day and a total holiday, the only people left at the airfield were the air traffic controllers. They were most hospitable, and as soon as the aircraft had been parked and locked up we were transported to La Paz and a comfortable hotel. Customs and Immigration, we were told, would not be available until the next day. The winding road dropping 2,000ft from the airfield affords a fine view of the city with its sprinkling of modern buildings and mixture of corrugated iron and red-tiled roofs.

Next morning we went by taxi up to the airfield where we were to spend most of our time (except for a visit to Cochabamba, Bolivia's second city and a mere 8,000ft up). The taxi-driver had two boys with him and they travelled in the boot; judging by the chatter and laughter we could hear when the engine was idling, they didn't really mind whether they had air or not. People living at these high altitudes have 40 per cent more red corpuscles in their blood than those at sea level. We soon found that even a slight slope up had to be taken gently, but we saw Indian workmen scrambling at high speed up steep slopes as soon as the base-work was sounded. During our four days' stay we carried on with our work—some of it quite energetic—and tried to ignore the thinness of the air. We must have been fairly successful, for there was no absenteeism and no complaints.

At the airfield we were greeted with the usual Latin-American courtesy; the Customs man, after threatening to seal the doors of the aircraft but being told we had come to give some demonstrations, finally settled for a note of the cameras we had with us. Throughout our tour we received the most polite and understanding treatment from Customs and Immigration officials. Some maxims, the result of experience in other parts of the world, probably helped. For example: be reasonably polite and smile; shake hands with everyone on arrival—and show a complete

G-AOEN and the El Alto terminal buildings

ignorance of the language. It helps, too, if you don't happen to be smuggling anything.

Our stay was mainly devoted to demonstrations and everybody was duly impressed by the performance of the aircraft and Alvis Leonides engines. The latter, without any adjustment, started up every time with no trouble. This caused some surprise, because the rarity of the atmosphere usually upsets the mixture for starting and a good deal of trouble is experienced.

W/C. Capper, the author of this article, is chief test pilot and flight manager of Scottish Aviation Ltd., manufacturers of the Twin Pioneer

We did not have time to learn much about La Paz and Bolivia, but with our trip to Cochabamba we saw quite a lot of the country from the air. The weather was good and we saw fine-weather cumulus cloud of the kind which, at home, is usually at two to three thousand feet; at El Alto it was at nineteen thousand. Round the airfield there are some fine ranges of snow-covered mountains rising to 21,000ft and some of the British residents spend their week-ends ski-ing at fantastic heights.

La Paz is made very picturesque by the brightly coloured clothing of the Indian women. Instead of the distinctive tall white hats they are reputed to wear (and do wear in other parts of the country), those in La Paz, almost without exception, wore grey, black or brown bowler hats—all about three sizes too small and perched at the most absurd angles on the tops of their heads. The story goes that some determined businessman from the North of England took out a consignment of bowlers; being unable to sell them to the men, he persuaded the women to buy them, and they have been buying them ever since.

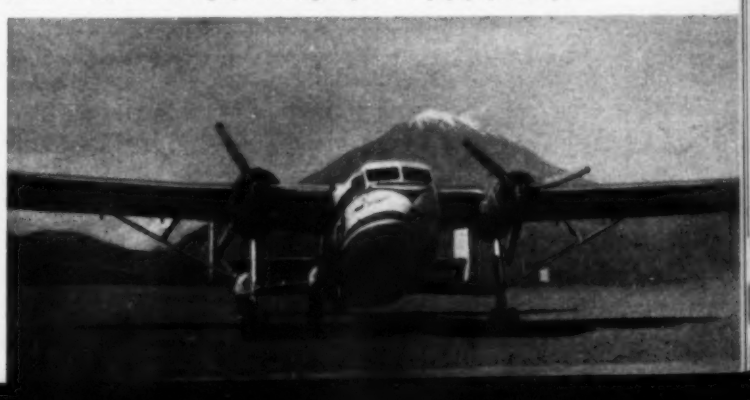
The standard of living is low and the illiterate percentage of the population very high. The difficult thing to understand is why anyone should have established a city so high up. The Spaniards, who founded it in 1548, are said to have chosen the location in order to avoid the chill winds of the plateau. One wonders why they were on the plateau in the first place.

In spite of there being insufficient oxygen to warrant the city having a fire brigade the way of life seems much the same as anywhere else. There was no shortage of hospitality with excellent food and the usual drinks. We tasted one of the finest Yorkshire puddings ever—cooked by a Bolivian cook in La Paz. It was probably the last thing one would expect to come across in such an odd place. Although the cost of living is reasonable a hotel bill looks like a statement of the national debt or an exercise in astronomy; when we were there the Boliviano, the unit of currency, stood at 7,000 to the dollar.

We left La Paz on May 5 in brilliant sunshine. I had intended to fly straight to Iquique, but on checking weights decided that to take off at high altitude with any suggestion of an overload might bring the tour to an abrupt end; so we adjusted our fuel load and changed our destination to Arica, a free port just in Chile. Having said our "good-byes" we took off from El Alto and climbed gradually to 17,000ft for our crossing of the Andes through a gap. I had the idea that once we were through we should just "coast" down to Arica; but instead we had to keep our height over miles of the wickedest-looking, ridged and rocky desert, ten to twelve thousand feet up and just about as bad as anything encountered in the Middle East. It was not until we were quite near the coast that we could let down for a landing on Arica's sandy runway. Our reception was hospitable (even to the landing fee, which was only one dollar), but we decided to go on to Iquique rather than stay the night at Arica. A stop for fuel at Antofagasta and a night stop at La Sarena and then to Santiago in Chile for a few days and some demonstrations.

There is some pretty high ground near Santiago, but—no doubt as a result of our visit to La Paz—I wrote in my diary, "Mountains on the way to Santiago child's play."

Left, Corporacion Boliviano C-46—and Indian woman in bowler hat. Right, refuelling stop at Arequipa, 9,000ft up



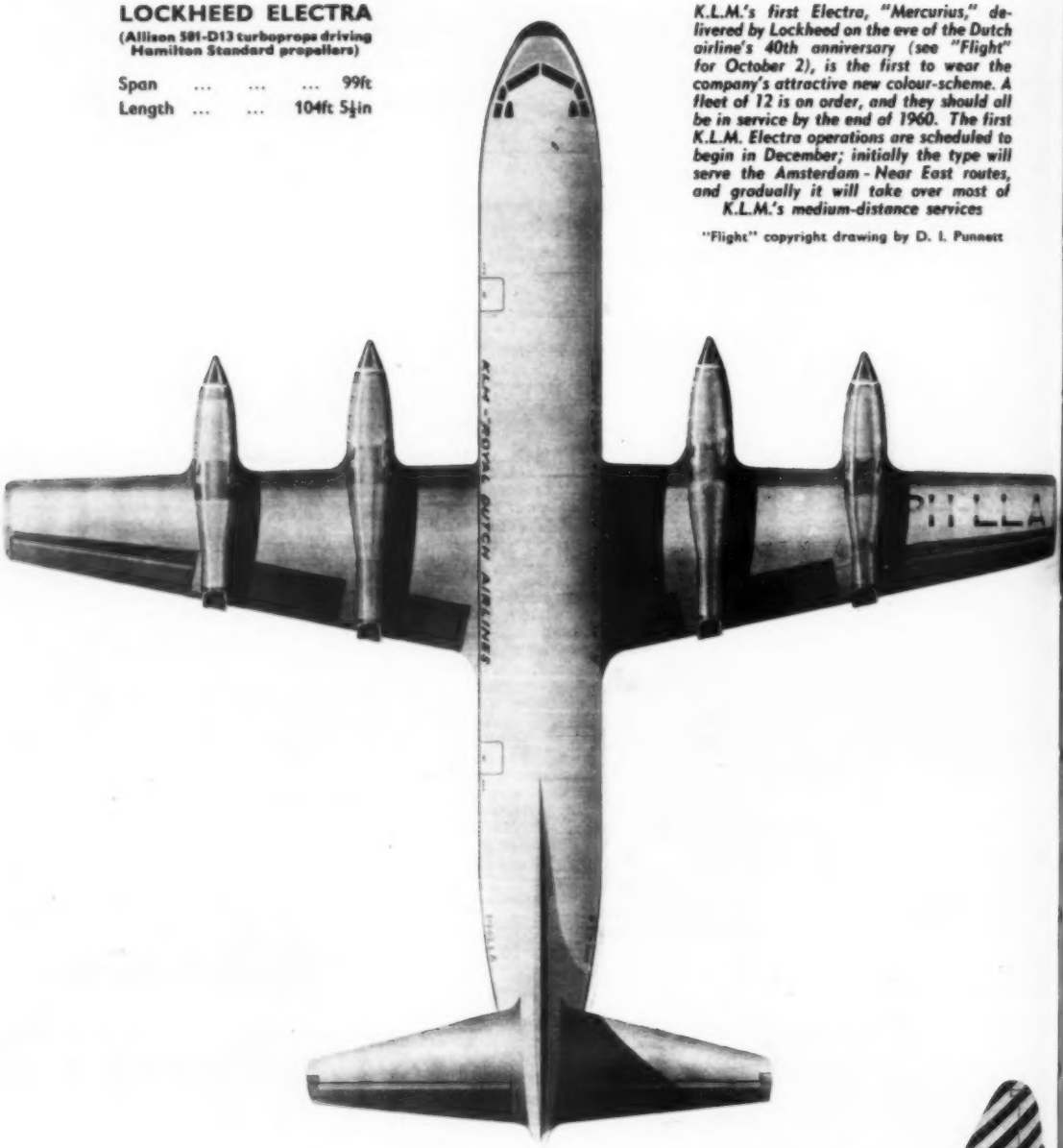
LOCKHEED ELECTRA

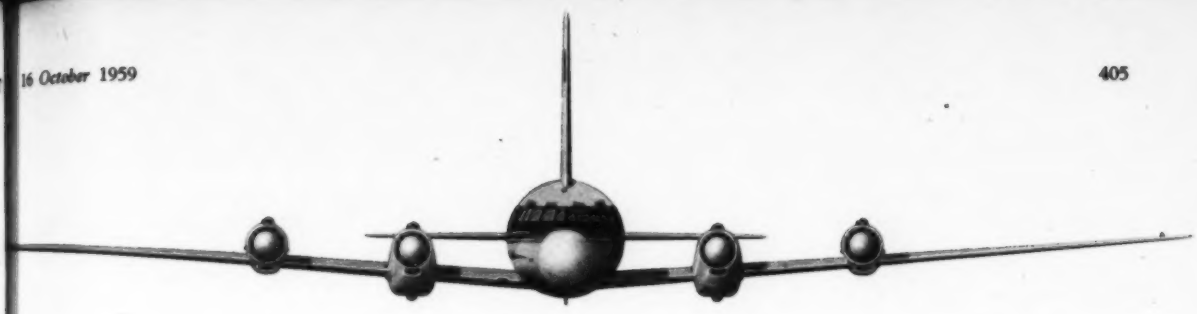
(Allison 501-D13 turboprops driving Hamilton Standard propellers)

Span	...	...	99ft
Length	...	...	104ft 5½in

K.L.M.'s first Electra, "Mercurius," delivered by Lockheed on the eve of the Dutch airline's 40th anniversary (see "Flight" for October 2), is the first to wear the company's attractive new colour-scheme. A fleet of 12 is on order, and they should all be in service by the end of 1960. The first K.L.M. Electra operations are scheduled to begin in December; initially the type will serve the Amsterdam - Near East routes, and gradually it will take over most of K.L.M.'s medium-distance services

"Flight" copyright drawing by D. I. Punnett





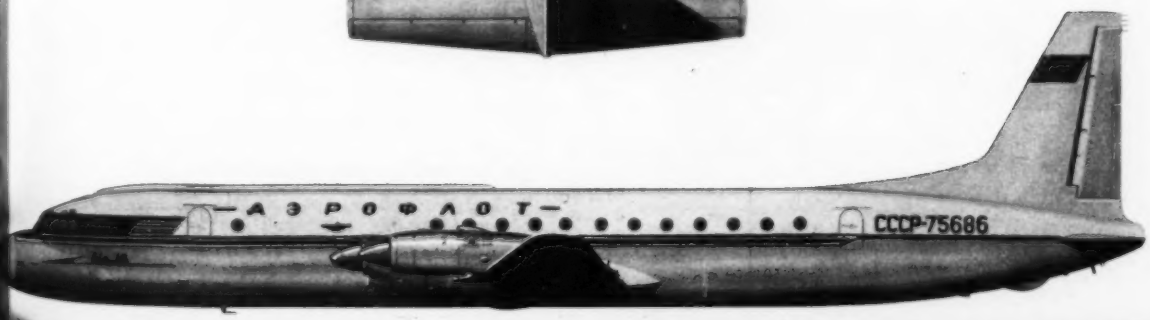
Regarded by many as the most "competitive" of Russia's new crop of transport aircraft, Sergei Ilyushin's fine turboprop airliner—known as the Moskva, or Moscow—entered scheduled passenger-carrying service with Aeroflot last April. The first route served by the Il-18 was that between Moscow and Alma-Ata, a major resort on the Black Sea shore. More than 40 Il-18s are now in service on a number of routes, and the national Czech carrier C.S.A. is reported to be likely to operate the type

"Flight" copyright drawing by D. I. Punnett

ILYUSHIN Il-18

(four Ivchenko AI-20)

Span	...	...	122ft 8in
Length	...	...	117ft



Sell and Forget?

By G. C. SCOTT

EXAMINATION OF A CRITICISM LEVELLED AT THE BRITISH AIRCRAFT INDUSTRY

THE selling of commercial aircraft can be likened to the progress of a space rocket. Some explode and disintegrate on the launching pad, others never seem to get away because of technical hitches. Of those which leave the pad, some fail to go beyond the first stage, and others stop at the second. Finally, there remain a few which fire through all stages successfully, and break through into outer space.

If we compare the sales of current British commercial aircraft by this analogy, the final stage, outer space, would be the equivalent of the break-even quantity of aircraft sold. Currently, the Viscount is the only aircraft which has indisputably gone into a sales "orbit." The Britannia, Heron, Comet, Twin Pioneer and Vanguard, are among those which must fast be approaching the firing of the final stage. The Argosy, Rotodyne and Avro 748 appear to be making promising progress, following successful firing of the first stage, and the Dart Herald will, it is hoped, very soon be joining them.

It is the group in the second stage which must be causing the industry the most anxiety at the present time. If we face facts, we must accept that (with the possible exception of the Vanguard) all these aircraft should have gone into "orbit" by this time.

What are the factors behind this sales resistance to our commercial aircraft? It seems all wrong, when we are so certain in our own minds that these machines are second to none in their individual classes. And yet, within the association of the British Commonwealth, there must be a market of vast potential, ready-made for British aircraft, if only we could find a means of tapping it.

After-sales Reputation. The real reason for our present predicament could be *reputation*. There are, unfortunately, many British manufacturers who still have a bad reputation for supporting their products after sale; a bad reputation quickly gets around in the airline world, and potential customers will soon lose interest in manufacturers who are known to give poor service. Our bitterest critics will not deny that British aircraft are as good as their competitors when they are serviceable and flying, with everything in them working properly. But we do have a reputation of being the "sell and forget industry," and we must accept that this reputation is not entirely undeserved.

During a visit to the United States (to a manufacturer who had then sold 100 of a new transport before the prototype had flown) the writer met a director of after-sales who said that he knew with *certainty* that his customers would be satisfied because of a parts and spares organization which was second to none. But there was no need for a representative of British industry, he said, to come all the way to visit his company, because Britain had such an example in our own Rolls-Royce. Nevertheless, he felt that there were no close seconds to Rolls-Royce and that, generally speaking, Britain was five to ten years behind in after-sales service.

It is a good thing to have an opportunity sometimes, "to see oursels as others see us," provided that it does "frae mony a blunder free us," and we should, as an industry, endeavour more to see ourselves through the eyes of our customers abroad. It is they who are our most important customers in the long run.

Operators' Complaints. Among a number of complaints are that the lavish promises made by the salesmen over the gin and brochures are not kept. Parts information may be late, incomplete, inaccurate, obsolete, or not available at all. There are no price lists, and customers' orders seem to vanish into British factories, with nothing more being heard of them until the parts turn up at the customer's base months or even years later. In other words, operators are unable to find out from British manufacturers: (a) Which are the spare parts. (b) Which spare parts they should order. (c) How much they will cost. (d) When they will receive them.

The following comment from an operator abroad, is unfortunately not an isolated example: "If we can receive into our stores parts from an American manufacturer some 10,000 miles distant within two months from the date of our order, we should reasonably expect that our orders on yourselves for similar parts could be dealt with promptly since you are but 6,000 miles away. Your delivery estimate of six to seven months is therefore quite unacceptable."

The packing of parts also, deservedly, comes in for severe criticism. There are often complaints that components arrive damaged and corroded after a long sea journey.

There is a feeling among a number of overseas operators that British manufacturers are not particularly worried about other customers, as long as they can keep the Ministry and the Corporations reasonably satisfied. It is irritating for a foreign operator to find that he has to make-do with confusing Ministry parts catalogues, for example, because the manufacturers give preference to the Ministry. This is a very dangerous policy which has cost the industry much in goodwill abroad.

There are companies who can claim that they have already met these complaints which are directed against the industry as a whole. One example has been quoted, and there is evidence that Armstrong Whitworth intend to start the Argosy series off on the right foot. It may also be worth bearing in mind that there are no Ministry orders for the Viscount, currently our only truly successful—and efficiently supported—commercial aircraft.

There are many other firms who have still to put their after-sales houses in order, and the following measures are recommended for consideration: (a) Managements should brief their salesmen to ensure that they do not make promises which cannot be kept. (b) After-sales organizations should be equipped and ready to ensure that the salesmen's promises *will* be kept. (c) Provisioning teams, staffed with engineers, experienced, equipped, and paid for their complex and responsible task, should be ready for action immediately the flow of production drawings begins, if not sooner. (d) Parts production must not be regarded as left-overs, or as a convenient reserve to cover up failures in the aircraft delivery programme. The emphasis should be on parts rather than on "Spares." (e) Complete sets of parts documents, initial recommendation, price book, and illustrated catalogue, should be issued to customers as finished products, immediately after signature of the contract, and be followed-up with revisions at regular and frequent intervals. (f) Commercial operators expect progress statements on outstanding orders at monthly intervals from their suppliers. (g) The packing of parts is a science deserving of research, and of expenditure on proper materials and equipment. (h) Ministry requirements should never be allowed to interfere with those of the commercial market.

The Ancillary Industry. It is felt by many operators that the biggest offenders—in their contribution to the "sell and forget" reputation—are companies which belong to the ancillary group. That this might be true, is supported by the evidence of recent articles in *Flight* on the subject of systems in British commercial aircraft. A number of British firms are having their equipment replaced both by operators and by the manufacturers of British aircraft.

No doubt there may be certain technical advantages in some American components. But in most cases operators would agree that there is little to choose *when the British equipment is working properly*. The rub comes when the component has gone unserviceable in an aircraft ready for departure: a failure has been traced to a simple defect which can be cured by the replacement of some trifling item and up to this point the matter is routine. It is when these small but vital items are found not to be in stores, but thousands of miles away in a British factory as a shortage on an order placed long ago, that chief engineers all over the world start saying rude things about us.

At least fifty different manufacturers contribute one or more components each to the modern commercial aircraft; for the larger machines, the number will exceed a hundred. Each one of these components, electrical, electronic, hydraulic, mechanical, or pneumatic, will at some period in its operating life require parts and after-sales service. There are manufacturers in the ancillary group who are aware of their responsibilities, and who are taking steps to ensure that their equipment is supported properly everywhere. Unfortunately, there are many others who are not.

Complaints and criticisms which have already been applied to the aircraft manufacturers apply equally to ancillary firms. [illegible]

Armstrong Whitworth: "starting off the Argosy on the right foot." The manufacturer's brochure of the parts provisioning scheme

Sell and Forget? . . .

additional and serious complaint is that manufacturers sometimes have the impertinence to tell customers that they do not know what they are talking about. As an instance, an American operator of British aircraft required breakdown parts to overhaul a small electrical component. After a wait, the parts were refused, and the manufacturer further demanded that the components be returned to their works in England for overhaul, with a turn-round time of several months. The final straw was for this operator to be told that he would not be capable of overhauling these components in his excellently equipped workshops which the ancillary manufacturer had certainly never seen. The result: the industry lost a further point or two in trade and reputation.

The background to the British ancillary industry's weakness appears to be threefold in origin. Firstly, the interests of manufacturers are divided between commercial products, Government contracts for guided weapons and atomic energy, and ordinary aircraft equipment. Secondly, "the Government will pay" attitude still prevails in some quarters. It is a grave dis-service to the whole industry that there are still manufacturers who are able to get away with inflicting "anything will do" upon commercial customers abroad. Thirdly, there is within the British industry no clear-cut division of responsibility for after-sales to the customers of ancillary equipment; the latter are seldom quite certain who—if anyone—is going to supply parts and service. As a rule, British manufacturers claim that they accept full responsibility for after-sales of ancillary equipment in their aircraft. But salesmen's promises are not always followed up by action from the after-sales departments and the following two examples are evidence of a lack of a co-ordinated policy.

Canadian Unfortunate Example. An operator of a British commercial aircraft in Canada required a minor breakdown part for the overhaul of a British ancillary component. He identified the part, by the part number (marked on it), and by a one-word description only, e.g. "123456 Bolt." This was included in a bulk order for miscellaneous parts, forwarded to the *aircraft manufacturer's* distributor in Canada. The latter immediately transcribed the order on to one of his own order forms, and posted it to the parent factory in Britain. Thus the aircraft manufacturer received an order for various aircraft parts without the manufacturers being identified by name. Neither was it clear to him which particular operator or operators originated the demands.

In this instance, the aircraft manufacturer identified the ancillary manufacturer from the part number quoted and in due course this item was included with a number of others in a bulk order from the aircraft manufacturer to the ancillary. The latter assumed that this part was required for use by the aircraft manufacturer himself, and did not therefore query its final destination. All his stocks of the part, however, were with his own distributor in Canada, in anticipation of just such a demand as had arisen from this very operator there. The part was recalled from Canada, and was returned to England by sea. From the ancillary manufacturer it passed across the country to the aircraft manufacturer, and from there back by sea to the latter's Canadian distributor. So, after a wait of many months, the operator received a part which, if only he had known, he could have obtained within a week.

African Unfortunate Example. In this example, the operator had two types of British aircraft originating from different manufacturers. Each aircraft was fitted with an electric motor, identical except for mounting and drive, an essential part for which is common to both applications. In the two aircraft however, the motors drove different hydraulic pumps in unrelated systems.

The performers in this interesting drama around a small part worth a few shillings were as follows:—

Title	Identification
Operator	A
First aircraft manufacturer	B
Second aircraft manufacturer	C
Electric motor manufacturer	D
First pump-unit manufacturer	E
Second pump-unit manufacturer ...	F
Distributor for D in Africa	G

One operator in Africa, five manufacturers in Britain, and one distributor in Africa.

Owing to the difficulty in identifying ancillary manufacturers' breakdown parts from the aircraft manufacturers' parts catalogues, parts were stored by A in part-number order, located according to their aircraft. Thus there were two separate stock-record entries in A, for this one part manufactured by D. A stores shortage arose for the part for servicing one of B's aircraft, and a purchase order was shortly on its way from A to B, stating no more than the part number, bare description, and quantity of the part required. One week later, a further shortage arose for the same part, this time for one of C's aircraft, and so C also received an order, almost identical to that which had reached B.

The spare parts department in B was quick enough to note that the part was made by D, and this was included in due course in a bulk order from B to D. On the other hand, C came to the conclusion that this part was manufactured by F, as it belonged to the motor which is part of F's pump assembly, and their order therefore goes to F. Of course, F knew that the part came from D and so, after a week or two of paper-work processing through the factory, F's order moved along the line to D.

Rolls-Royce: second to none in service after sales. But are there enough close seconds?

At the U.K. end therefore, D eventually received two separate orders for the part, one several weeks later than the other, although they started out from A only one week apart. D did not know the first origin of these orders, and so the two consignments of the same part were sent off on their separate journeys to A. The consignment via B arrived six months after the original demand arose, and that via C and F, eight months after, so that the original gap increased from one week to two months. D's distributor in Africa, G, was unaware of these transactions from start to finish, and was left out altogether. Neither did any of the other performers know that D had a distributor who could provide parts service to A within a maximum of two months from order (instead of eight).

The conclusions which can be drawn from these two examples—they are not by any means isolated cases—are that it is no excuse for British manufacturers to point out that these operators could have saved themselves a lot of trouble if they had themselves been more alert and efficiently organized. They are fairly typical of the average commercial operator. Instances of this kind have contributed heavily to the industry's bad reputation for parts service; they emphasize the urgent need for a co-ordinated information service which will enable any customer anywhere in the world to find out the right method of obtaining parts from any British manufacturer.

Distribution. A solution is required to the whole problem of the distribution of parts for the ancillary industry. As we have seen from the examples quoted, operators abroad are frequently unaware that there are local distributors and agents for the ancillary equipment in their aircraft. As a result, it is more than likely that they will order parts from Britain. The solution is simple. The aircraft manufacturer should make it quite clear to his customers that he does not normally accept responsibility for after-sales for ancillary equipment. When occasionally, for technical reasons, there must be exceptions, the customers must be told exactly what these exceptions are. The next stage is to let the operator know how and where he can obtain parts and service for his ancillary equipment—all of it, even including Air Ministry referenced parts.

Immediately the subject of parts comes up for detailed discussion after the sales contract has been signed, the customer should be given a list of all the proprietary manufacturers associated with the aircraft and their addresses in the United Kingdom. The addresses of the vendor's service agents in or nearest to the customer's country should also be provided and the customer should be recommended—in his own interests—to establish contact as quickly as possible.

At the same time, when an aircraft has been sold to a new customer, the aircraft manufacturer should notify all the vendors that the after-sales support of their equipment is their responsibility entirely, unless otherwise agreed. The vendors should in turn get in touch with the customers immediately, and establish the after-sales procedure to be followed for equipment, parts, servicing, literature, and everything.

A contribution of the greatest value would be the wider dissemination by the S.B.A.C. of their after-sales directory for industry. This would enable the operators, by quick-reference on the spot, to find out the simplest and quickest method of obtaining parts and service for any component in any British aircraft, anywhere, and at any time. We shall gain for ourselves a better reputation if we can tell our customers the truth about ourselves from the beginning. There is nothing which creates a worse impression than for a customer to be told one thing before he signs the contract, and then to find out that the opposite is the case after the aircraft has been delivered. If we can tell our customers as much as we can about our after-sales service, instead of as little, and if we can deliver the goods, we shall at last deserve a reputation of "Sell and Support."

Straight and Level

WERE you surprised that Mr. Hugh Strangeways, Planes Minister in the last Government, lost his seat in the election?

Nor was I—his record was execrable. But it is with dread that I await the appointment of the new man to this key office. He could be even worse.

The ideal choice, in my view, would be Mr. Anthony Doubletalk, Minister of Football in the last Government, who returns with a big majority. He would bring to the Planes Ministry a wide experience of Big Leagues, team spirit, common goals, pools, and so forth.

● I am delighted to see that the epic stanzas of "The Seven Days of Farnborough" (*Flight*, September 11) have been reproduced abroad. Acknowledgement is made by the editor of the journal concerned—*Aviation Week*—to "Flight" magazine, "a British aviation publication." *Aviation Week* is an American aviation publication.

● "I want in the years to come to show my children the Spitfire and the Hurricane as I and so many others remember them—alive and in their natural element, not as dust-covered museum pieces."—A correspondent in *Flight* last week.

How much emphasis can I possibly put into the words: *So do I—?*

● *"The cult of speed in the air, often presented so that it appears as a form of lunacy, is in fact part of the search for economy."*—The Economist.

The operative words here are "part of." Speed can indeed bring down direct operating costs, *all other things being equal*. The other things are payload, range, basic weight, and fuel weight. With an equal payload and range, and with comparable technical expertise, a jet and a turboprop do not appear to have equal basic weights and fuel weights.

Take a look at the formula for calculating direct operating cost. It shows that costs are very sensitive to fuel weight and basic weight, and a moderate increase in each could well outweigh the cost-reducing effect of a 50 per cent increase in speed.

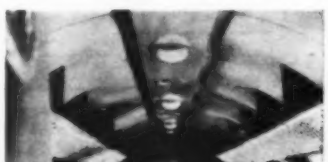
And this is what has been happening. I would say that speed plays a relatively minor part in the search for economy, unless it can be obtained solely by the reduction of drag.

* * *

Of course, operating costs aside, it is argued that increased speed means increased earning power and hence profitability. Aircraft for aircraft (jet *v.* turboprop), this may be true, especially if the fares are the same. But fleet for fleet, because more turboprops are required to do a given traffic job, total profit may actually be higher for the turboprop fleet. "Ah, yes," it might be argued, "but what about the return-on-investment angle?"

Taking into account the whole of an airline's capital, the rate of profit for a turboprop fleet could still be higher than for a jet fleet. I say "could" because I feel it is wrong to be dogmatic about these matters, which must remain theoretical while the airlines price low speed the same as high speed.

As for speed being "presented as a form of lunacy," is it not lunacy for an industry to compete only in the speed and quality of its service, when such competition means unnaturally high obsolescence costs and capital charges? It would not be lunacy if speed were all that the public wanted. But it isn't. They want . . . well, there's no need for me to say it.



If this picture of a Morris Mini-Minor in a DC-3 had been a drawing by James Thurber, the caption would no doubt have been: "Okay, okay, . . . so there's a car coming down the aisle." [Explanation: p. 412.]

● Remounting my aft-facing hobby-horse after re-reading a year-old edition of *The Log*, I quote S/L. D. I. Fryer, Secretary of the R.A.F. Institute of Aviation Medicine's Accident Panel:—

"We feel that it is incorrect on the strength of evidence offered so far to assume, as many have, that in the majority of survivable accidents correctly designed forward-facing seats offer as much protection to passengers as correctly designed rearward-facing seats . . ."

It seems reasonable to conclude from this statement that aft-facing seats, in the view of the aviation medical authority most qualified to judge, are likely to save more lives than forward-facing seats.

Why then do the airlines continue to operate with forward-facing seats? And why does the Government prefer British servicemen and their wives and children to be transported in aft-facing seats?

It is easy to look back at aviation ten or twenty years ago and say: "That was wrong." It is not so easy to condemn contemporary practice; and it is still harder to do something about it, especially when big business is involved.

The puzzling thing is that there is not a shred of evidence to show that an airline which fitted aft-facing seats would lose a ha'porth of revenue. And it is shocking that a government which admits that aft-facing seats "give an extra margin of safety in some circumstances" (see *Flight*, May 22, page 727) continues to shirk its duty in this issue of safety.

What shall it be—safety first? Or commercial considerations first?

● "O.K., start up, check in on King, keep rolling and take off in pairs, left right, high low. Join up in finger for the climb, change to natter channel and I'll wave you out when we're on top. Call trailing. We'll stay below and I'll waggle you in to stooge. A quick tail chase afterwards and the first man with eighties calls bingo. Let down in pairs for a normal run-in and break."—British-type formation-flying jargon. I offer it to counterbalance the U.S. Navy jargon published in this column five weeks ago, just to show that the Americans haven't got the monopoly of jargonization.

● By and large, manufacturers of hardware are well aware of the fact that their products have to have a name or an easily remembered designation if they are to receive a good Press. Even a difficult designation—such as Douglas YKC-124B—is better than nothing at all.

But what does one do with the new "corps support missile" being developed for the British Army by English Electric Aviation? According to the *News Chronicle* its code name is "Blue Water." But this name is apparently highly secret, and is not to be seen by anybody (except by readers of the *News Chronicle*).

I would not mind this at all if only English Electric would think of a name themselves; and this should not be difficult, with Lightnings and Thunderbirds in the family.

● "It is fairly obvious that it is at landing and take-off you get the accidents."—*Lord Douglas, B.E.A.*

"Lest you should be left with the impression that take-offs and landings are the primary cause, my recollection is . . . that the main cause of accidents a few years ago was collision with hillsides and things of that kind."—*Sir George Cribbett, B.O.A.C.*

ROGER BACON

Ansett-A.N.A. were the first operators to receive production Friendships with Rolls-Royce RDa.7 engines and at the newly certified weight of 37,500 lb. The only modifications were a larger undercarriage drag-stay bolt, a different nosewheel shock-absorber and the fitting of Dunlop "two-plate" brakes. First deliveries were made at Amsterdam on October 5

AIR COMMERCE

LOW FARES AND BIG JETS

AMONG the wise men of air transport few have been more vocal, more insistent, or more constant in campaigning for low fares than the director-general of the International Air Transport Association, Sir William P. Hildred. Presenting his report *World Air Transport in 1959* to the annual general meeting of I.A.T.A. at Tokyo on October 12—his annual task of reviewing the state of health of now-87 I.A.T.A. member-airlines—Sir William once again preached what he termed his "article of faith."

Looking back over the past year, said the director-general, the picture could be made darker or lighter depending on the statistics that were used to describe it. I.C.A.O.'s figures for the world's airlines showed that although there had been an absolute increase in traffic there was a decrease in the rate of growth to which we had become accustomed, with only mail traffic maintaining an increase at the conventional rate. The cargo growth-rate traffic was down and passenger traffic had increased by only 2 per cent against 12 per cent the preceding year.

But any depression that these statistics might cause was hardly justified, because it was so largely accounted for by the drop in passengers carried—from 45.3m in 1957 to 44.9m in 1958—by U.S. domestic operators, and this fall had been caused by recession (which had reduced their revenues by about £71m) and by the concatenation of strikes that had cost the U.S. airlines about £8.3m. If we took as a barometer the purely international traffic of I.A.T.A. members the horizon cleared a good deal more.

Overall traffic showed an increase of 14.8 per cent in terms of tonne-kilometres performed in 1958—a good deal closer to the 16.4 per cent increase of 1957.

"The year 1958," said Sir William, "was not one of our better years. But figures now available for the first half of 1959 . . . show traffic rising on an ebullient curve for both international and U.S. domestic operations." Like a child's temperature, air traffic had immense resilience. It was soon up and soon down and it responded to lower fares and attractive facilities.

Speaking of the financial state of the airlines, the director-general said that in his estimate for last year an operating profit of 1.2 per cent had been shown by I.C.A.O.'s revised financial figures to be optimistic; in 1957 there was actually an operating *loss* of £14.5m, or 1 per cent of revenue. Estimates for 1958 indicated a further deterioration; although total operating revenues were up, expenses were even higher, and the world airline industry was going to be in the red by about 3.7 per cent in 1958. Factors contributing to these results were the U.S. strikes, the recession and "comparatively massive re-equipment," as well as the operation of fully amortized but rather more costly-to-maintain older aircraft.

The past year had been memorable, said Sir William, for two developments: the jets and economy fares. Whether we had got the mixture right remained to be seen, but this was the medicine for future growth and much of what would appear in I.A.T.A.'s reports for the years to come would harp on these two themes.

With the jets there was going to be capacity of an order that the airlines had never been called upon to fill before: "We shall have to feed progressively larger gobbets of traffic to these monsters or they will eat us up, capital and all." This was where economy fares came in. They provided the impetus which pushed North Atlantic traffic ahead by 26.8 per cent in 1958 and they were responsible for something like 222,000 new passengers. It was clear that the economy class had created its own market, pointing to the moral that markets were inexhaustible "so long as we keep fares down, down, down."

If people had a little more money to play with, he continued, air travel would get a good share. An American estimate indicated that if a consumer's income was increased by 1 per cent, 3 per cent more of his income would be spent on air travel. "This does not happen with his beer or his boots or his bread or his umbrella," said Sir William and it was a Heaven-sent opportunity for the airlines. The problem was to attain the highest possible economy of operations as the basis for the lowest possible price, and to squeeze the greatest amount of traffic out of whatever market that price level enabled the Association to exploit.

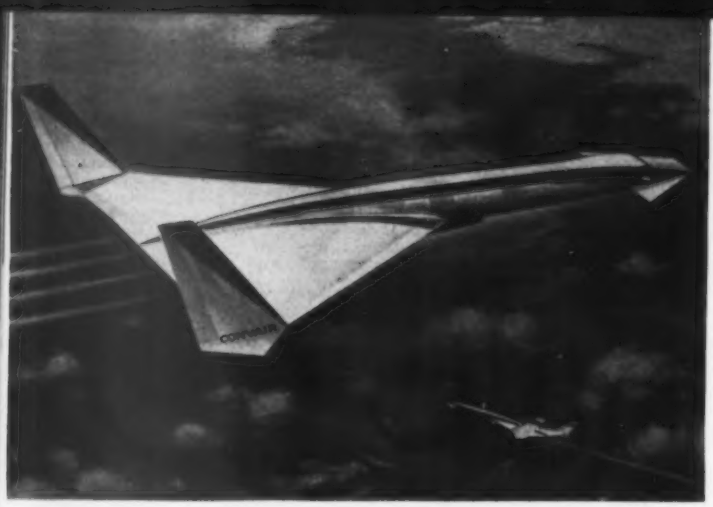
"Our economic future," the director-general went on, "depends on operating the jets at their optimum efficiency. In one minute a jet consumes an amount of fuel equal in weight to a man and a dog." Restricted flight-paths, due to military operations or to a limited airways complex, imposed severe penalties and he urged governments to be as sympathetic and helpful as possible. They were not always so over user charges, which were currently standing the airlines in to the tune of £18m per annum. The short period between promulgation and starting date of higher charges was a matter for serious concern: "Committed as we are to get fares down, operating with miniscule profits or, indeed, with overall loss, airlines have no cushion to absorb new or increased charges . . . we may not be geese, but we can lay golden eggs—so long as we are not starved out of production."

A new line of attack for I.A.T.A.'s director-general was economic research. Airlines needed on their staffs, he said, young men trained in general economic theory, men who thought of the ambience of the industry and not merely of its problems.

Another point which the director-general brought to the attention of the a.g.m. was that over the past ten years women had become the majority among American travellers abroad and held more than 55 per cent of all U.S. passports. More passports were obtained by secretaries than by engineers, military personnel, retired people or teachers. More nurses than bankers got passports. The total pay cheques of women employed on the American continent added up to £16,000m a year—"a magnificent, charming and attractive challenge!"

So far as cargo was concerned, said Sir William, 1959 would be a better year than 1958, but it would not be good enough. The amount of space sold by present rating systems and sales appeals would be even smaller than the capacity offered. It was an opportunity rather than a serious problem, and there were several ways in which the challenge could be met in the next decade.

Finally, Sir William Hildred quoted the Select Committee on Nationalized Industries in its affirmation that I.A.T.A. was here to stay, that the alternative was anarchy and that everything considered, the Association's advantages outweighed its disadvantages. "We must expect, from time to time," said Sir William, "competitive friction, government against government, government against airline, airline against airline." This was not a bad thing and would make for better airlines and better service. Capacity restrictions imposed by governments would not be a better solution. "We all know what happened to grandma with her tight stays. She swooned every 20 minutes and faded away at 50."



Mach 3-3.5 Convair: Artist's conception of a supersonic, shovel-nosed 2,000 m.p.h. airliner for the 1970s. According to Mr. R. C. Sebald, vice-president engineering of Convair, it would be windowless and would cruise at 60-80,000ft. It appears to be one of the projects discussed at the I.A.S. "supersonic symposium" in New York ("Flight," March 13)

AIR COMMERCE . . .

FUTURE OF U.A.T. AND T.A.I.

THE Paris correspondent of *The Times* clears up some of the confusion which exists about the future rôle prescribed for France's independent airlines U.A.T. and T.A.I. in competition with the State airline Air France. As in the United Kingdom, the participation of private airline enterprise in international air transport has always been a matter of controversy. U.A.T. is linked to the shipping company Chargeurs Réunis and T.A.I. is linked to the shipping company Messagerie Maritime. Both operate between France and the French community in Africa; and in addition T.A.I. operates on the Indian Ocean, Far East and Pacific routes.

Since 1955, as a result of the Peira-Cava agreements which laid down the principle of equal shares between Air France and the private companies on all international routes, the controversy has been dormant. More recently U.A.T., which operates in West, Central and Southern Africa, has been in conflict with Air France, and the Minister of Public Works and Transport, M. Buron, has intervened in an attempt to patch up the quarrel.

Two things appear to have brought matters to a head: the formation of Air Union (of which Air France's 34 per cent, *Flight* learns from Air Union, includes T.A.I. and U.A.T. in proportions not yet determined), and the attainment of independence by African states in the French Community (likewise a problem for the relations between U.K. state and independent airlines).

The internal routes of these states have become the responsibility of the countries concerned, who are eager to develop their own national airlines with French aid. The dispute has raged, says *The Times*, over whether Air France or U.A.T. should give it to them. The Minister has decisively recognized the "African vocation" of U.A.T., which will from now on have a free hand in setting up national airlines in the French Community, and in which it will have a part share.

A committee has been established to co-ordinate the activities of Air France and the private companies, but it will have some tricky problems. *The Times* asks what will happen if, for example, Mali Airlines (yet to be formed) start up a new route from Dakar to New York? Or if the Congolese equivalent runs cut-rate flights from Brazzaville to Geneva? Air France is afraid that U.A.T. will be in a position to edge Air France out of the international African routes by skilful co-ordination of its international and internal flights, designed to attract traffic one from the other.

As in the U.K., whenever private enterprise challenges the traffic of the Corporations, the French trade unions representing Air France's staff have protested vigorously, and are trying to whip up public opinion in their favour. But there is apparently no evidence that M. Buron regards this as a matter of idealogical discussion. "The almost complete public indifference to air politics," in marked contrast to the situation in Britain, stems partly from the fact that nationalization has never for long bulked large in France as a political issue. *The Times* says that questions of public versus private enterprise are on the whole left to the technocrats, and M. Buron's action gives every indication that economic efficiency is his prime consideration.

EXPANSION AT DUBLIN AIRPORT

WORK will shortly begin at Dublin Airport on runway and apron extensions, and on a new hangar and workshops, for Irish Air Lines' Boeing 720 aircraft. The new buildings will adjoin the present engineering site on the north side of the airport and will entail the closing of a road linking the airport's north-eastern boundary to the main Dublin - Belfast road.

DANGER: SLUSH

ONE of the conclusions of the inquiry (see *Flight*, March 20, 1959) into the accident to the B.E.A. Elizabethan at Munich on February 6, 1958, was that "slush on the runway did not increase rolling friction to such an extent that the accident could be attributed to this."

This verdict of the German report has never been accepted by the British Air Line Pilots Association nor, in particular, by Capt. James Thain, the captain who was involved. The latter has made persistent efforts to have the inquiry re-opened and a recent letter which he sent to the West German Transport Office is now under consideration. Meanwhile a decision on a new hearing has been postponed, although Herr Reichel, a member of the accident inquiry commission, said in Bonn earlier this month that all information so far received indicated that there was no need to re-open the inquiry.

Whatever the outcome of the German discussions, interest has been increasingly focussed on the effect of slush on take-off performance. In the current issue of *Boeing Magazine* there are some first-hand facts about jet performance on slush-covered runways; they are reproduced here in abbreviated form.

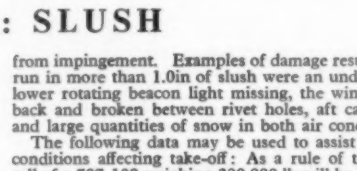
Taking off in slush [says the article] may produce two effects. Undoubtedly the most serious is the possibility of the airplane not attaining lift-off speed before running off the end of the available runway. Actual data is difficult to establish but the curves show the general effect of slush on the runway and give some idea of the increased ground-roll distance to be expected. The curves also disclose another factor which must be considered. Some take-off procedures call for an acceleration check by noting the time required to accelerate from brake release to 100 kt, in order to allow the pilot to determine before reaching V_1 speed, whether the airplane is accelerating as expected for the prevailing conditions. But the curves show that slush effects are scarcely noticed at low speeds. Only during the later, high-speed, portion of the take-off acceleration does the slush affect the rate of speed increase. An acceleration check on the time needed to reach 100 kt would probably not disclose the fact that acceleration would be less than expected from that point until lift-off. Take-off under conditions where field length required equals field length available should be carefully considered when heavy wet slush of over one-half inch depth exists.

The second effect to be considered is possible damage to the aircraft from impingement. Examples of damage resulting from one 707 take-off run in more than 1.0in of slush were an undercarriage fairing damaged, lower rotating beacon light missing, the wing-body fairing edge peeled back and broken between rivet holes, aft cargo door skin peeled back and large quantities of snow in both air conditioning ram-air scoops.

The following data may be used to assist in evaluating variations of conditions affecting take-off: As a rule of thumb, the take-off ground roll of a 707-120 weighing 200,000 lb will be increased about 10 per cent with ½in of water or watery slush on the runway. At 247,000 lb, the increase in ground roll with ½in of slush would be about 15 per cent. Similarly, the take-off ground roll of a 707-320 weighing 240,000 lb will be increased about 10 per cent with ½in of slush on the runway. At 296,000 lb, the increase in ground roll would be about 15 per cent.

Although there is little factual data on which to base a recommendation, it is believed that up to one-half inch of slush on the runway during take-off will not result in damage. Even though there was substantial structural damage during the take-off with more than an inch of slush, there was no failure of the landing gear or door retraction systems during either the retraction or extension cycle; half an inch of slush will probably not coat door edges or the landing gear with enough slush to prevent a normal retraction.

When a take-off is planned from a slushy runway, pilots should make sure that the full length of the runway has been cleared and the depth of slush throughout the take-off run should be considered prior to any take-off.



Velocity-distance plot of 707 take-off through V_1, rotation and lift-off speeds at 240,000 lb weight and zero wind and runway slope

Mach 3-3.5 Lockheed: Artist's conception of a supersonic, pointed-nose airliner, also for the 1970s, discussed by Mr. Hall Hibbard, Lockheed's vice-president engineering, on pages 392-393 of this issue. It would have conventional turbojets, a steel and titanium airframe, and be operational by 1965. Lockheed consider this to be the next step in commercial air transport

EASTERN EXCESS

NOTWITHSTANDING the resurgence of U.S. domestic traffic, and the statistics which show how the jets have contributed to this resurgence, one carrier at least is acknowledging that it has over-ordered. In evidence before the C.A.B. in the course of the "southern transcontinental" route case, Eastern Air Lines estimate that the cutting back of their DC-8 order from 20 to 16 last spring cost the airline a total of about £125,000. In the same hearings, E.A.L. say they will still have four DC-8s and ten surplus Electras by 1960 unless awarded a Southern Transcontinental route.

Eastern has 16 DC-8s on order, and the first are due to be delivered in November. The number of Electras on order amounts to 40, all but one or two of which have now been delivered. (The airline also has options on six further DC-8s and 30 more Electras.)

Ten Electras are already surplus to requirements; and four DC-8s—eight by the end of 1961—will represent excess jet capacity unless Eastern is able to extend its route system.

Capt. Rickenbacker blames the C.A.B.'s policy of multiple competition, and also the airline's inability to dispose of its piston aircraft, for this situation. "We have no market and neither has anyone else," Capt. Rickenbacker said, and E.A.L. "sees no hope" of disposing of its Lockheed 749s.

Two of E.A.L.'s L.1049Cs are being converted by the airline to all-cargo use, and a further 16 are available for conversion at a cost quoted as £53-£89,000 per aircraft. (Eastern are thus following the lead given by American Airlines and United Air Lines, who have respectively arranged for the conversion—by Douglas—of ten DC-7Bs and six DC-7s for cargo use.) According to E.A.L. the converted 1049Cs, with big doors and heavy floors, would have direct operating costs of less than six cents per ton mile, excluding depreciation, on transcontinental routes.

Since these illuminating facts and figures were given, Capt. Rickenbacker has stepped down as chief executive of E.A.L., though he remains chairman of the board. In this position he will concentrate on long-range policy. The new chief executive—and president—is Mr. Malcolm A. MacIntyre. The former president, Mr. Thomas F. Armstrong, becomes an executive vice-president. Mr. MacIntyre, a former under secretary of the U.S. Air Force, is a lawyer and a former Rhodes scholar at Oxford.

NEW CODES FOR TAKE-OFF

HAMMERED out at the I.C.A.O. Airworthiness Committee meeting in Stockholm during July and August were new aircraft performance requirements that now only await the Organization's full approval before they become the basis for new national airworthiness codes. Among the most significant aspects of the Committee's work has been that on take-off for which a complete new range of terms—already airline pilots' jargon—has been conceived. The following explanation is condensed from the Monthly News Bulletin published by I.F.A.L.P.A.

The take-off case today is largely dominated by the requirement that the aeroplane must *leave the ground* at 1.15 (piston engine) or 1.2 (jets) times the power-off, free air stall. The essential difference in the case of the new code is that this condition is not required to be met until the aircraft is *35ft above the runway*. Thus, between the surface of the runway and 35ft is a segment not protected by a 15-20 per cent margin above the stall. But other protection provided by the new specifications is claimed to be as good, and certainly to be adequate to prevent difficulty in getting airborne or sinking once in the air. But an exact comparison of the old and the new specifications is complex since the datum and the technique applied to take-off have been fundamentally changed.

The important speeds associated with the old take-off were (1) the stall (V_{S1}); (2) the minimum control speed (V_{MC}); (3) the decision or power-failure speed (V_1); (4) the take-off safety speed (V_2); (5) the initial climb speed (V_2 or V_{2+}). There were various connecting links between these speeds but, as indicated above, the one usually dominant was that V_2 had to have a 15 per cent (pistons) or a 20 per cent (jets) margin above the stall.

The important speeds associated with the new take-off are: (1) the stall (now V_S); (2) the minimum control speed (V_{MC}); (3) the engine failure *recognition* speed (V_1); (4) the minimum unstick speed (V_{MU}); (5) the rotation speed (V_R); (6) the unstick or lift-off speed (V_{LOF}); (7) the minimum take-off safety speed (V_2 min) and (8) the initial climb speed (V_2). Space does not permit the full description of all these terms but the overriding points to be borne in mind are that lift-off (V_{LOF}) is governed by 12 per cent above minimum unstick (V_{MU}) and is—in the normal case—assisted by ground effect; and V_2 min (the old V_2), with its 20 per cent (jets) margin above the free air, power-off stall, is now not specifically required till 35ft is reached.

The important newcomers are V_{MU}, V_R and V_{LOF} and their connection is as follows. Unstick or lift-off and all speeds up to the 35ft height point (at which V_2 min is reached) are mainly dominated by V_{MU}. This is a speed used *only in certification trials* and is the lowest speed at which the aeroplane can be made to leave the ground and climb away safely. This should, of course, be substantially above the stall but it is difficult to relate to the stall because (1) most aircraft gain from ground effect (usually considered to apply up to $\frac{1}{4}$ wing span height) and it may therefore be possible to unstick at or very near to the stall, which is a *free-air power-off* figure; and (2) the stall itself, as measured in U.S. certification trials, is not the same as the stall known to pilots and can, in fact, be much less (Comet 4, 5 kt; DC-7, 7 kt; KC-135, 9 kt). Anyhow, the fact remains that a test pilot must demonstrate that, for various weights, the aircraft can be made to unstick at V_{MU}. This figure is then multiplied by 1.12 to give the lift-off speed. This is 'the speed at which the aircraft first becomes airborne' and is the speed applied in the normal operational take-off.

The rotation speed (V_R) is the lowest speed at which the nose gear should leave the ground. However, the rotation speeds currently being applied to jets are based on the American SR-422 code and thus associated with the old V_2 (usually $V_R = V_2$ less 5-10 kt), while the new rotation speed (which will probably be applied to all jets in the very near future) is not directly related to V_2 but to V_{MU}, as described above. It is also related to the stall ($1.1\ V_S$) and to the minimum control speed ($1.05V_{MC}$) but these will not usually be dominant.

Summarizing, once the nose gear has been raised at a speed between V_R and V_{LOF} the aircraft should climb away, reaching V_2 min speed by 35ft or earlier. On leaving the ground the most likely dominant protection is the 12 per cent above the 'worst leaving condition' (V_{MU}) and at 35ft the dominant protection is approximately the same as we have always had at the old V_2, though with perhaps a small loss due to slipstream effect being greater than the 5 per cent allowed for as between the $1.15\ V_{SI}$ (piston) and $1.2\ V_{SI}$ (jet) specification.

STRIKE THREAT TO AER LINGUS

THE Irish Airline Pilots' Association have objected to the method of selecting aircrews for the Irish Air Lines new Boeing 720 fleet and have threatened strike action unless the system is modified.

Ten captains and ten first officers have been selected from the Aer Lingus total of 110 pilots for the Boeing training course, and, in addition, 14 pilots from the Irish Air Corps have been recruited as "systems pilots" to complete the new three-man crews of the new aircraft. Irish Air Lines pilots, at present flying Aer Lingus Viscounts and Friendships, are complaining that the 20 Aer Lingus pilots chosen were not selected on the basis of seniority of service.

When the present pilot shortage caused by the training programme has been overcome (Aer Lingus are currently advertising for aircrew for their United Kingdom and European services), it is anticipated that all further aircrew members will be initially recruited as systems pilots. These pilots will complete a two-year navigation and engineering course before joining the Boeing 720 crews as "third man." After completing a Boeing tour, they will go as first officers on Viscounts and Friendships (or, perhaps, Vanguards?), before becoming first officers, or junior captains, on Boeings. This, then, is the new Irish pattern of airline promotion.

Aer Lingus/Irish Air Lines issued the following statement on October 3, 1959: "The company attaches particular importance

AIR COMMERCE . . .

to the initial selection of crews for its Boeing 707 jets in view of the fact that the aircraft and their operation will be quite different from anything to which their pilots are presently accustomed. Normally, selection for promotion on aircraft types can be based on seniority alone, as the pilots are already trained on those types, but this case is different and other factors must be taken into consideration in view of the substantial investment to be made in the training of those selected during the next 18 months.

"For that reason, the company selected the most suitable pilots for this type of training, and while seniority was considered, it was not the overriding factor. All pilot requirements have been met by Aer Lingus and no recourse has had to be made to other sources of supply.

"Discussions have taken place between the company and the pilots' association on this question and are still proceeding. No formal strike notice has been served."

GOING IT ALONE?

AS this issue of *Flight* goes to press it seems certain that the I.A.T.A. traffic conference at Honolulu wound up without agreeing on any significant extension of economy-class service. Despite the preliminary lip-service on the question of low fares (see in particular Sir William Hildred's words on page 409), the reason for the Honolulu deadlock must be summed up as: "The airlines cannot yet afford substantial fare cuts."

It now remains to be seen how B.O.A.C. will react to this disappointment. The Corporation has repeatedly made clear its determination to go ahead, backed by the Government, with the introduction of low fares on British colonial routes. The implication of this is fully recognized; it is that for the first time Britain will pursue a fares policy which undermines the international fare structure. The managing director of B.O.A.C., Mr. Basil Smallpeice, was expected to make a statement earlier this week.

ROUND-THE-WORLD JET

THIS week a PanAm 707 Intercontinental has been flying round the world on a three-day inaugural jet service. It arrived in Hong Kong on Monday after flying from New York to London and then via Frankfurt, Istanbul, Beirut, Karachi, Calcutta, and Bangkok. It completed the first 8,250 miles to Hong Kong in 15 hr 48 min flying time and 23 hr elapsed time, and was scheduled to go on to Tokyo, Honolulu and San Francisco before flying "over the Pole" to London. This flight marks the start of jet competition for B.O.A.C. on the latter's Eastern routes.

THE A.T.A.C.'s YEAR

JUST published is what could be one of the last complete annual reports of the A.T.A.C.* It is now almost certain that the new Parliament will amend the 1949 Air Corporations Act to provide British air transport with new opportunities and a new executive, rather than advisory, authority to regulate its expansion.

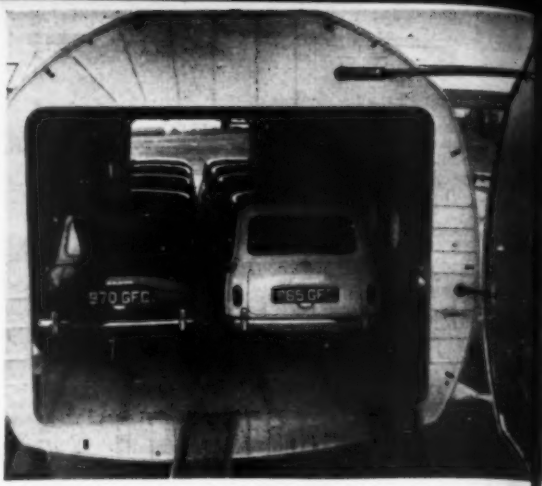
Surprisingly, no reference appears in the report to these impending changes, which were referred to three times, in Parliament and outside, by the last Minister during the year under review. And the event which more than any other high-lighted the inadequacies of the A.T.A.C. is referred to only briefly. This was the application, by four independents, to operate very low fare "V.L.F." services on British cabotage routes. Though this happened during the year under review, the report defers comment until publication of the next report.

The report gives the usual facts and figures about applications and recommendations to the Minister (all of which were accepted). As in the past, the Council deplores the lateness of many applications, and the overbidding for services (75 approved inclusive tours were not taken up). A whole page is taken up by a complaint from a member of the public, which the A.T.A.C. saw fit to submit to the Minister, about a delayed B.E.A. service. The report records also the important Ministerial directive of June 1958 that the A.T.A.C., and not he, should first receive applications for "circular tours" as well as for inclusive tours (since many circular tours were becoming rather too similar to I.T.s).

The report also records a "marked trend" for new operators to apply for scheduled services; such applications "gave rise to certain difficulties." The upshot was that the Minister ruled that, in general, companies should have 12 months' operational experience before being allowed to fly scheduled services.

The following passage is an unintended self-tribute to a Council which, despite its lack of analytical staff-work, has invariably been notable for its good sense. The A.T.A.C. believes that the operations of the independent companies "have not to any material extent adversely affected the growth of the traffic of the two Airways Corporations."

**Report of the Air Transport Advisory Council, 1958-59. H.M. Stationery Office, London, price 4s 6d.*



Here are eight new Morris Mini-Minors inside an AW.650, no doubt whetting the appetite of the air ferry operators for the AW.670 which it was announced last week, is now being developed. Sir Roy Dobson says that it may be in operation by 1962. This picture contrasts with that on page 408, which shows a Mini-Minor inside a big-door DC-3 of Tunis Air. It was being ferried for "Flight's" associate journal "The Autocar" between Tunis and Bône in the course of a journey described in this week's and last week's issue of that journal under the title "Mediterranean Mini-Go-Round"

DOWN FARES, UP REVENUES

EVERYONE knows that reduced fares mean increased traffic. The big question is: "Will such fares increase profits?"

The disappointing outcome of I.A.T.A.'s Honolulu traffic conference, which reached deadlock on the issue of extending economy-class services, suggests that I.A.T.A. have decided that the answer to this question is, for the moment, in the negative.

Yet the same association has just published a document which, when analyzed, suggests that not only did North Atlantic economy-class fares increase tourist-type traffic by 31 per cent in the period April-December 1958 but—more important—these fares increased revenues by 20 per cent.

These conclusions can be drawn from *I.A.T.A. World Air Transport Statistics, No. 3, July 1959.** This new edition of I.A.T.A.'s annual traffic review has only now been published, due to delays caused by the British printing dispute. Though the document makes but the briefest reference to money (in the form of Clearing House turnovers), it is possible to estimate North Atlantic revenues, accurate enough for the purposes of this comparison, by applying to the passenger statistics the appropriate basic North Atlantic one-way fare between London and New York. The periods to be compared are April-December 1957 and 1958.

First, referring to last year's edition of the document, total I.A.T.A. North Atlantic tourist traffic in April-December 1957 was 628,729. The appropriate fare was $290. In the same period of 1958, when economy-class was on offer, the number of tourist-class passengers (at $315 a-piece) plummeted to 162,533. However, economy-class passengers (at $252 each) were no fewer than 662,634. Thus in terms of tourist-type passengers as a whole (i.e., tourist-class plus economy-class, first-class being ignored as a self-contained market), traffic went up by a remarkable 31 per cent. The equivalent increase in revenues works out at almost exactly 20 per cent.

This means that, having introduced a fare 13 per cent below the *existing* fare in a particular tourist market, the airlines increased their turnover by a substantially greater amount. Had they judged their scheduling better, and achieved higher load-factors, the airlines would have made big profits—particularly since the unit cost of what they sold went down by reason of simpler service and higher-density seating.

By introducing the lower fare the airlines not only sold more but earned more. Of course, no one can tell by how much business might have increased had economy-class not been introduced. And the picture is somewhat distorted by the fact that a quarter of the tourist-type traffic carried was the old tourist-class paying an 8½ per cent higher fare. A perfect assessment of the effect of economy-class would have been possible only if it had entirely replaced tourist-class. But there remains strong evidence to support the belief that economy fares not only give more people a ride: they can, if scheduling is well judged, increase profits. On I.A.T.A.'s own evidence, the answer to the question: "Will economy-class fares increase profits?" must be in the affirmative.

J. M. B.

**Published by I.A.T.A. at 1060 University Street, Montreal, 3, price 50 U.S. cents or equivalent.*

B.E.A.'s RECORD SUMMER

A CLEAR profit of £4.5m, inclusive of interest on capital, was made by B.E.A. during its six months' summer season. This news was given by Lord Douglas last week, who made his customary cautionary comment that a "large part of this profit during the coming relatively slack winter months" might be lost. An important contribution to this surplus, which was a record, was a load factor of 73 per cent compared with 65 per cent during the summer of 1958. Traffic was up by about 20 per cent for an increase in capacity of about 5 per cent.

Writing in the *B.E.A. Magazine*, Lord Douglas refers to B.E.A.'s helicopter plans. The Corporation probably requires, for interim services before the Rotodyne is introduced, two 20/25-seat, multi-engined helicopters "in the class of the American Vertol V.107 and Sikorsky S-61 or the British Bristol 192C." He expresses himself "most favourably impressed" with the Vertol 107.

THE SEA AND THE AIR

"THE nature and degree of competition between sea and air has, as I see it, been greatly exaggerated in the public mind because the two types of transport each serve in their respective ways essential and complementary needs." This was said by Mr. R. G. Grout, President of the Institute of Transport, in London on October 12. Mr. Grout, who is chairman of the General Steam Navigation Company, was making a presidential address, with the title *Transport—the Mainspring of Progress*, at the inaugural 1959-60 session of the Institute. He continued:—

"The air provides swift transport for passengers, light mail and small freight, while the sea can carry in a rather more leisurely manner not only large numbers of passengers in greater comfort, but also huge loads of bulk cargo in a manner and at a cost with which the air liner neither can nor will ever be able to compete.

"It is true that some years ago the Berlin Air Lift seemed to prove that, given the sense of urgency and the aircraft, and with no regard whatsoever paid to expense, a huge city could be succoured entirely by air services. But the strain and tension of that experience also showed quite clearly that we are not yet even in sight of employing air services as anything but an essential complement to the more traditional means of transporting cargoes in bulk. I think this provides the answer to those who may have begun to feel that . . . the age of the sea is passing."

After praising the M.T.C.A. Mr. Grout voiced a view often echoed in air transport circles: "It has always amazed me to think that one Minister and his team can possibly embrace all the facets of transport from inland waterways, railways, roads and their maintenance, docks and harbours, to shipping and air . . ."

HERMES ACCIDENT REPORT

THE accident to the Skyways Hermes 4 G-ALDV at Meesden Green, Hertfordshire, on April 1, 1958, occurred as a result of the elevators being jammed by "a small extraneous object which was not found."

In his report* on the accident, Mr. J. W. Duggan, Deputy Chief Inspector of Accidents, finds that the aircraft—which had flown a total of 12,697 hours—was properly certificated.

The Hermes took off from Stansted in fine weather and climbed steeply towards the north-east. A few minutes later it was seen approaching the airport from the west at about 1,500ft. Some 15 min after take-off the second pilot radioed Stansted tower that there was an emergency and that the controls had jammed; the aircraft was seen some six miles north-east of the airfield descending in a series of dives and climbs. It crashed in a field at Manor Farm, Meesden Green, and the greater part of the wreckage was destroyed by fire. All the crew, Capt. G. D. Rayment (in command), Capt. J. A. West (second pilot), and engineer officer N. Bradley, were killed.

The control mechanism in the stern-frame bay was dismantled and deep, bright score marks were found on the face of the movable elevator datum lever adjacent to the fixed ground-lock latch housing. Experiments were carried out on another Hermes in which a piece of 14 s.w.g. brass wire was introduced into the appropriate part of the control mechanism and an attempt made to operate the elevator controls from the cockpit. They could be moved only with great difficulty. The datum lever taken from the crashed aircraft gave some indication that previous interference between the fixed and movable parts had taken place. Score marks of recent origin were superimposed on others of greater age.

A datum lever was then operated in a test rig and a new $\frac{3}{32}$in splitpin was introduced between the datum lever and the latch housing. By application of a load of between 110 and 115 lb (equivalent to a force of 55-60 lb on the pilot's control column) it was found that the splitpin could be forced between the two components and that considerable effort was necessary to return the datum lever to its neutral position. "The heaviest scoring," notes the report, "undoubtedly resulted from the progressive deterioration of the object causing the jamming, and it is reasonable to deduce that the force required to move the jammed controls became more than the pilots could exert." Found in the wreckage, and in the stern-frame bay of another Skyways Hermes, were a number of small extraneous objects. "The attention of the Skyways inspection department . . . was drawn to the matter at once." The report adds "the necessity for absolute cleanliness cannot be emphasized too strongly."

*H.M. Stationery Office, London, price 2s.

BREVITIES

The possibility that T.A.A. might purchase £25 million worth of British jet airliners for delivery between 1963-66 was referred to in Melbourne on Monday by Mr. Warren McDonald, chairman of the Australian National Airlines Commission. He said that the Vickers VC.11 and the Airco D.H.121 appeared to be the only aircraft available at that time which would satisfy T.A.A.'s needs. Pure jets would replace turboprops on all inter-State services by 1966.

As from November 1, it was announced by Aeroflot in London last Monday, Il-18s will replace Tu-104As on the London - Moscow route. A spokesman referred to the problems of stacking Tu-104s in bad weather conditions.

Douglas Aircraft's Santa Monica and Long Beach Division engineering departments have been combined into a single organization known as Transport Aircraft Engineering.

American Airlines have taken delivery of the first of ten DC-7s converted by Douglas for all-freight use. The type is known as the DC-7F Airfreighter and has a payload of 33,500 lb.

P.I.A. has ordered from Fokker three Rolls-Royce Dart RDa.7-powered Friendships with an option of an additional six. Delivery of the three against the firm order will be made during 1960.

Mr. D. Anderson, Australian Director-General of Civil Aviation, said recently that he expected a pooling arrangement between British, Indian and Australian airlines on the London to Sydney route to be concluded before the end of 1959.

Following Silver City's announcement of reduced winter fares, Air Charter's Channel Air Bridge fares to Calais, Ostend and Rotterdam have also been reduced for the period October 15 until May 31, 1960. The Air Bridge carried 19,000 vehicles and 93,000 passengers during the last financial year.

Hawaiian Airlines have placed options on three to six turbofan DC-8s for delivery in 1961; one aircraft will be Douglas's own DC-8, taken on a lease-purchase basis. The order is contingent upon the award of new trans-Pacific routes. The airline say that DC-8s can be operated out of Hilo without the need for "expensive modifications of the runway."

U.A.T. has bought two Skymasters from South African Airways for £76,784 each.

A B.E.A. team has recently visited the Bréguet factories to obtain information on the Bréguet 940 and its derivatives.

It is now confirmed that Alitalia have placed orders for four Caravelles, with an option on four more. This brings the Caravelle orders to 55.

As "a matter of policy" Derby Town Council have agreed to develop the disused R.A.F. airfield at Castle Donington, North Leicestershire, as an East Midlands airport.

International Aeradio announce the forthcoming retirement, on December 31, of W/C. R. C. Lowes, O.B.E., operations manager. He will remain a consultant to I.A.L.—whose management has recently been strengthened by Mr. L. M. Layzell, as technical manager; Mr. E. E. Warburg, commercial manager; and Mr. J. P. Utterson, personnel manager

M.E.A.'s re-equipment plans include the purchase of about five new turboprops. Sheikh Najib Alamuddin has said that three types are under consideration and that he has no plans for jets for two years. When new aircraft are bought some of M.E.A.'s seven Viscounts will be retired.

A delegation of six M.T.C.A. officials headed by Mr. M. M. V. Custance, Deputy Secretary, arrived at the Washington headquarters of the F.A.A. on October 6 to discuss common civil-aviation problems. The party was due last week to visit the F.A.A.'s National Aviation Facilities Experimental Center at Atlantic City. The British delegation's visit follows one by Mr. E. R. Quesada, F.A.A. Administrator, to the U.K. last May.

Sport and Business

SALES PROSPECTS of the Aeromere Falco, being sold in this country by Mr. C. H. Cosmelli (12 Chalkhill Road, Wembley Park, Middlesex), appear to be good—and certainly this delightful aircraft deserves every success. Close inspection of G-APUO, first machine in this country, showed superb finish of fabric and multiple coats of dope over plywood skin, all fairings being blended into the finish and leaving virtually no structural joints visible. Flashing navigation lights and metal flaps, ailerons and rudder are standard. Each of the three undercarriage wheels has its own screw-jack for retraction operated by a single electric motor or standby hand-crank. Flaps can be electrically set to any angle up to 45 deg. The nosewheel is connected to the rudder pedals and, though heavy to move, gives precise control and a tight turning circle. It is particularly useful in completely cancelling out a strong tendency to swing left early during take-off. Hydraulic disc brakes at each mainwheel are operated together by pressing with a heel on a lever between the rudder pedals.

Although it fits like a glove, the cabin is comfortable and remains reasonably quiet in flight. Good ventilation and heating are provided. The sliding canopy is firm and slides freely, being fastened shut by a firm and positive "pop-bottle" snap-over linkage. The top portion of the canopy is tinted dark green and virtually obscures vision. Despite very real benefits in providing shade this is a handicap for aerobatics and leaves a rather shallow clear side window. A plain shoulder harness anchored to the floor ahead of the seat, without a lap-strap, is typically Continental—effective, but not really comfortable.

C. M. Lambert of *Flight*'s staff, after a recent flight from Denham, writes "I had flown a Falco briefly at Paris and I now flew G-APUO mainly to reassure myself that it was not 'hot' at low speeds despite its remarkably high cruising speed. In any case an STR.9X 44-channel radio and some loose gear precluded aerobatics. Take-off was perfectly straightforward as the initial urge to swing left could be held with the steerable nosewheel and seemed to disappear by the time the Falco became airborne. The controls were very light and the rudder was particularly sensitive: a certain amount was required during the climb, but virtually none after that and the feet are best firmly propped on the floor to keep the pedals still. Stability and handling generally left nothing to be desired and I concentrated on stalls and particularly on the margin of g close to the stall.

"In clean configuration there was a noticeable buffet some 5 to 10 m.p.h. above the stall, caused by leading-edge strakes, before a stall came at a highish angle of attack and at about 70 m.p.h. Either wing might drop, according to directional attitude at the time, and the nose went down. It was a proper stall, but not vicious and with no tendency to progress into a spin. Recovery was immediate and positive, and really crisp aileron control remained until the last instant. With wheels and full flap down, the judder warning came much later and was followed almost immediately by the same firm kind of stall, but at less than 62 m.p.h. I.A.S. Again, lateral control remained and recovery was immediate. At about 64 m.p.h. a sharp pull back on the stick caused immediate stalling, but at 75 m.p.h. there was plenty of lift left and a sharp, almost vicious round-out could be safely made. In three consecutive stalls, one of them held until a steep spiral dive had developed, we lost about 1,000ft of height.

"Although the stall was quite definite and a wing might drop in either direction, the Falco behaved remarkably well and was exceptionally manageable at the lowest speeds. Trim changes with flap and power were very small in all cases. The flaps gave a big increase in lift and drag so that a glide at 80 m.p.h. with gear down and 45 deg flap produced 1,100ft/min and a useful approach gradient. Approaches could comfortably be made at 80 m.p.h. or even less, with really crisp control. The nosewheel should be held up as long as possible during the ground-run. The brakes were powerful and easily killed the last 30 m.p.h. in a short distance. Denham is a particularly nasty field, using the approach over 40ft trees as we did, but we had no trouble in stopping.

"In view of the 186 m.p.h. maximum cruising speed, this performance at the low end of the speed range gives remarkable confidence, even though one knows that an inadvertent stall would lead to serious trouble close to the ground. Some 40 min in the air served to confirm my enthusiasm for the Falco as a really effective and useful touring and aerobatic aircraft."

"Flight" photograph

The first British-registered Aeromere Falco, handling impressions of which are given in the first item on this page

ANNUAL DINNER of the Association of British Aero Clubs and Centres will be held on December 2 at the Waldorf Hotel, London. Recently joined members of the Association include Rhoose Flying Club, Easy King Flying Group and Alouette Flying Club.

ELSTREE FLYING CLUB competition winners this year, whose trophies were awarded on September 26, comprised Tim Davies (club champion and forced landing trophy), John Duer (navigation), Peter Laffy (technical knowledge), Derek Ward (circuit competition) and Tony Webber (student pilot). Following the tie between Laffy and Davies in the contest for the technical knowledge trophy, the finalists were given the choice of further questions or a race for a pint of beer. They settled for the latter.

The winter series of lectures at Elstree covering navigation, theory of flight, aviation law, meteorology and other subjects begins this month, and for the first time attendance is open to members of other flying clubs.

A SLINGSBY SKYLARK 3b sailplane, ordered by the Russian Trade Delegation in London from Slingsby Sailplanes Ltd., is believed to be the first aircraft to be exported from the U.K. to the U.S.S.R. since the war.

RETROSPECT

From "Flight" of October 16, 1909

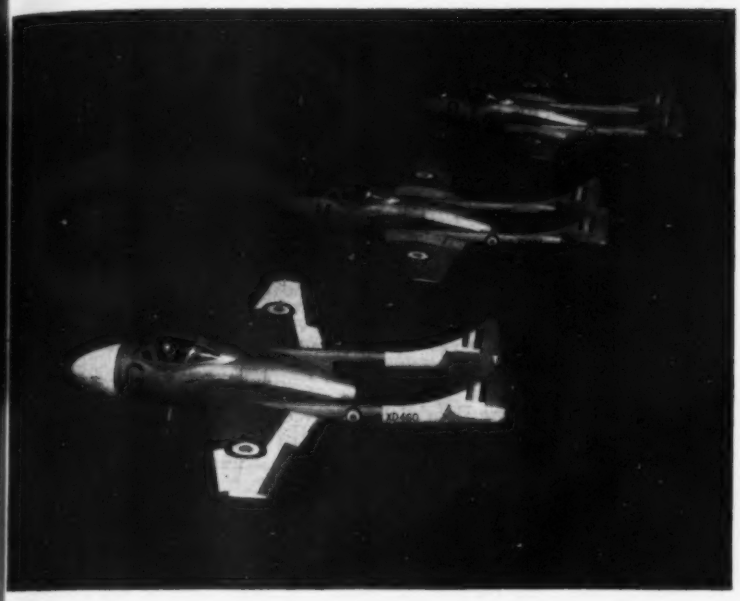
Terms in Flight: Kindly allow me to suggest that the gentlemen who put in type my letter, appearing in your issue of October 9th, are merry fellows; given to "flights" of fancy, at least. I wrote "decks", but they made it "ducks"! An omission of a comma gives "the triplane six upper wings"!

They perhaps were thinking of landrails or water-rails when they put "counter-rails". The word "countervail" must be most unfamiliar to the sportsman. Had they been yachtsmen they would have put taffrail instead of counter-rail, if either word was connected with flying.

The use of the word "banking" for the voluntary inclination given to the machine to assist turning, is rather clumsy in use. To my mind a far better term would be "listing". Almost as good is "heeling". But "list", "listing," "listed" to right, or left, with "right-list" or "left-list" are terms that would be clear to the boating man and many others.

It should be quite clear, however, that by "right-list" is meant the inclination to the right, or the depression of the right wing. I presume "banking" is the other way? By banking to the right we get the left list, and *vice-versa*—Faithfully yours, T. Osborn Smith.

Presentation of the Popular Flying Association's Masefield Trophy to the Armstrong Whitworth Flying Group was made on October 2. Here P.F.A. chairman Harold Best-Devereux makes the award to Mr. H. M. Woodhams, A.W.A. chairman and managing director and also president of the group. Also present were group chairman J. Nicholls (left) and secretary D. O'Clarey



Vampires of the Central Navigation and Control School with cadets of No. 181 (City of Gloucester) Sqn., A.T.C., as passengers; a photograph taken by F/L. Russell Adams, the Squadron C.O. Some 16,571 A.T.C. members attended camps at R.A.F. stations this summer

SERVICE AVIATION

Royal Air Forces and Naval Flying News

Personal Contact

ALL Commands in the United Kingdom have lately been visited by the Chief of the Air Staff, Marshal of the R.A.F. Sir Dermot Boyle, who has thus in recent months made personal contact with the whole of the great Service of which he is the professional head. At the beginning of this year he flew himself by Canberra on a 20,000-mile tour of the Far and Middle East Air Forces, and in April he went to see R.A.F. Germany.

Sir Dermot feels that these visits serve a dual purpose—enabling him to keep in touch with the Service (he is a firm believer in the importance of the C.A.S. meeting and talking with individual officers and men), and enabling the R.A.F. at large to have a better understanding of policy decisions emanating from Whitehall—affecting the size and shape of the Service, its equipment and deployment—and the reasons lying behind them. For a typical reaction to one of Sir Dermot's talks, see the photograph at the foot of this page, taken when he addressed over a thousand officers of Fighter Command at its Stanmore Park headquarters.

Successful Participants

ALTHOUGH No. 617 Sqn. gained an overall success in this year's bombing and navigation competition (as recorded last week), individual awards went to other competing squadrons. In the navigation and combined bombing and navigation categories the winners were S/L. P. A. Ward and his crew from No. 83 Sqn. (Vulcans); and a Valiant crew of No. 7 Sqn. with F/L. B. W. Wellicome as captain won the individual bombing award. Six crews from each squadron participated in the competition, which forms the culmination of Bomber Command's annual training programme. It was held on three consecutive nights and included "attacks" on targets in London and north-east England.

G/O. Anne Stephens, due to succeed A. Cmdt. Dame Henrietta Barnett next March as Director of the W.R.A.F. (with the acting rank of air commandant), is seen in the picture above talking with W.R.A.F. members at their Notting Hill hostel. At right, part of another—but very much larger—audience for a senior officer recently. The varied expressions of concentrated attention are explained in the adjoining column

The Duchess of Gloucester, Air Chief Commandant of the W.R.A.F., is to visit the Central Navigation and Control School at R.A.F. Shawbury next Thursday (October 22).

* * *

Marshal of the R.A.F. Sir Dermot Boyle, C.A.S., is today (October 16) to review students who have been attending the 100th command and staff course for junior officers at R.A.F. Bircham Newton.

* * *

G/C. S. J. Bailey, appeals secretary of the R.A.F. Benevolent Fund since 1949, has retired. His successor is G/C. G. P. Woodhouse.

* * *

Acting Cpl. L. S. Bateman of the R.A.F. Police has been awarded a Queen's Commendation for Brave Conduct for rescuing a 15-year-old Maldivian boy from drowning.

* * *

S/L. H. S. Carver, recently appointed an equerry (temporary) to the Queen, has been commanding the day combat squadron at the C.F.E. since last January.

* * *

An Argus of the R.C.A.F. recently set up a new Canadian record for a non-stop long-distance flight when it flew 4,570 miles from Hawaii to North Bay, Ontario, in 20 hr 13 min.

* * *

The annual dinner of the Nos. 7 and 14 R.N.A.S. and R.A.F. Handley Page Squadrons' Association is being held at the Coronet Bar, Soho Street, London, W.1, on Saturday, October 24, at 7 p.m. Further particulars may be obtained from G. Conley Esq., D.S.M., 62 Nightingale Lane, London, S.W.12.

* * *

A Shackleton of No. 42 Sqn., Coastal Command, flew out spare equipment to the ocean weather ship *Weather Reporter* on October 7. The vessel, at her Atlantic station some 300 miles West of Cape Finisterre, had reported a defective radar part in her navigation equipment. Supplying it by air involved a 1,360-mile round trip from St. Mawgan.

* * *

W/C. J. G. Wright of the R.C.A.F. has been awarded the largest cash amount ever to go to a member of Canada's armed forces—a total of $11,994—for his invention of the R.Theta computer, adopted by the R.C.A.F. for use in its all-weather intercepter aircraft. For this simplified navigational device, which provides course and distance to any destination set on it and is immune from radio interference, W/C. Wright was awarded the Trans-Canada McKee Trophy for 1954.

THE ANGLO-AMERICAN CONFERENCE (continued from page 399)

system. Subsequently a full-size Comet control rig was assembled on the factory floor and operated day and night for three years to prove its reliability.

During this period much use was made of the altitude test chamber at Hatfield, which can produce an equivalent pressure altitude of 70,000ft and a temperature of −70 deg C. This equipment proved invaluable in perfecting the pressurization apparatus (then, as now, operated from the engine compressors) and the temperature and humidity controls for the cabin.

It was found by experience that the testing of pressurized fuselage sections within the chamber was neither desirable nor practical. An early test specimen which gave way under pressure in the chamber produced an explosion sufficiently powerful to lift two of the chamber's two-ton bulkheads out of their seatings. To avoid this hazard subsequent pressure testing of the fuselage sections was done, for the first time ever, in water tanks at Hatfield. The Comet fuselage was designed to withstand a pressure of 2½ times its maximum working load, i.e., 20½ lb/sq in, and full-size specimens were repeatedly subjected to this differential without damage. The windows, always recognized as critical points, were subjected to a very practical endurance test. Specimen Comet windows mounted in a rig on the roof of the Hatfield factory were kept at working pressure every day for more than three years, during which times they were regularly cleaned as if in airline service. These specimens repeatedly withstood pressurizations of 100 lb/sq in. As a result of this work the static strength of the Comet 1 was proved not only to meet the Government requirement of the day but to meet the company's standard, which was 25 per cent higher than the statutory requirement.

Development of the Ghost engine proceeded in parallel with that of the airframe. The Ghost first ran in September 1945, and in July 1947 two of the new engines flew for the first time mounted in the outboard bearers of a Lancastrian bomber-transport. This aircraft and another like it were responsible for some 1,700 very useful engine hours in the following two years. This work was, however, handicapped by the fact that the ceiling of the Lancastrian was limited to about 23,000ft, far short of the Comet's cruising altitude. A Vampire fighter was therefore modified to take a Ghost engine. With slightly extended wings and with the 5,000 lb of thrust from the Ghost the Vampire operated without difficulty at 40,000 to 50,000ft, and provided valuable experience of high-altitude operation.

The First Flight

The first Comet flew on July 27, 1949, by which time the production line at Hatfield was well established. Fortunately all went well and as the flight tests proceeded it was found that the aircraft was up to calculated performance and no major modifications were called for.

The first two Comets built were for the Ministry of Supply and these two were used for test flying and performance measurement and later for route-proving flights by B.O.A.C. The first of the Comets for B.O.A.C. flew in January 1951, and by the end of that year four B.O.A.C. aircraft had been completed. On January 21, 1952, the Comet received its Certificate of Airworthiness and on February 4, some six months ahead of the contract date, the first Comet was delivered to B.O.A.C. at London Airport; other deliveries followed during March and April.

B.O.A.C. inaugurated the world's first public jet airliner service on May 2, 1952, with a 6,700-mile flight from London to Johannesburg in 23½ hours. At that time 45 Comets were on order, many of them for the Series 2 which was then being developed. The Comet 2 had a longer fuselage and the all-up weight was increased to 120,000 lb. The need for more engine power to meet these new conditions was met by the fitting of Rolls-Royce Avon engines of 6,500 lb thrust.

Meanwhile, B.O.A.C. maintained their Comet 1 services with marked success. During the first year of operation routes were extended to include India, Singapore and Tokyo, and the route mileage amounted to 21,000 miles. Passenger load-factors were exceeding 90 per cent and 104,600,000 revenue passenger miles were flown in the first twelve months. In service both the aircraft and its engines had proved exceptionally reliable and within 13 months the overhaul life of the Ghost engine was raised to 600 hours, an unprecedented figure for a turbine at the time.

Experience on the routes had shown that many of the so-called operational hazards which jet airlines would have difficulty in overcoming had not materialized. In practice the Comet has worked normally in and out of London Airport with its traffic congestion and its high incidence of bad weather. The Comet was never given landing priority and there proved to be no need to ask for such concessions. On occasions Comets were held in the approach pattern for as much as 90 minutes.

All seemed set fair for the Comet when, on January 10, 1954, there occurred the first of the two accidents which led to the suspension of Comet services. On that day an aircraft on a flight from the Far East crashed into the Mediterranean in mystifying circumstances. The services were temporarily suspended and many precautionary modifications were introduced, but the real cause was not then known. Soon after the resumption of services a second accident took place in similar circumstances, again over the Mediterranean, and all Comet services were suspended pending a detailed investigation.

The progress of the Comet inquiry, continued Sir Aubrey Burke, was now well-known history. Every effort was concentrated on solving the mystery. The Royal Navy evolved unique salvage techniques whereby some 80 per cent of the Comet structure was raised from the bed of the sea. The Royal Aircraft Establishment at Farnborough concentrated its extensive technical resources on the problem and the de Havilland company, with its future at stake, needed no other stimulus for a maximum effort to solve the problem.

Cause Established

These efforts were successful in establishing, without doubt, the fundamental cause of the two accidents. This might be briefly described as metal fatigue in the pressurized cabin structure, a phenomenon hitherto unrecognized and one which the court of inquiry found could not have been anticipated in the light of the knowledge then available.

As soon as the cause of the accidents became clear—some time in advance of the official inquiry's findings—work began on applying the new knowledge. The target aimed at and subsequently achieved was to give the aircraft a safe fatigue life of 20 years of airline service. Today a fatigue-life requirement had been established throughout the structure of the Comet 4. It was the first transport aircraft in history for which this new standard had been set, and perhaps still the only one.

The inquiry showed that the Comet 2, which was by then in production, and the Comet 3, the first of which was about to fly, would both need modification, and for a time all production work was stopped. But the company's confidence in the ultimate success of the Comet was still high and a suggestion that the name should be changed was never entertained. Work on the structural design went on without a break and in March 1955 a new version with still more power, range and payload, known as the Comet 4, was announced. Nineteen were ordered by B.O.A.C.

In the meantime the Comet 2s already on the production line were being modified for service with R.A.F. Transport Command. "These aircraft, ten of which were delivered to the R.A.F., have been in service since June 1956," said Sir Aubrey, "and have flown more than 22,000 hours in operational services extending round the world. In the main the modification consisted of a simple strengthening of the cabin in certain areas. It was the thoroughness of the investigation which took the time, not the amount of work done on the design. Similar modifications were made to two Comet 1As which had been in service with the Royal Canadian Air Force since 1953, and these two aircraft are still in commission; one of them was used recently by Queen Elizabeth and Prince Philip during their Canadian tour."

Atlantic Inauguration

The new Comet (having twice the power and twice the payload of the pioneer version, but embodying the same proved and uncontroversial basic engineering) made its first flight on April 27, 1958. Less than six months later, Comets of B.O.A.C. inaugurated the first Atlantic jet service. B.O.A.C. services had since been extended to India, Hong Kong and Japan, and Argentine Airlines had started services linking South America with Europe and the United States. Deliveries to the third and fourth operators were about to begin, and the company was now building Comets of several versions which offered the alternatives of higher speed or better range/payload characteristics, according to the needs of a particular route network.

"We are often told that the Comet must be the most thoroughly tested aeroplane in the world," concluded Sir Aubrey, "and that we believe. However, this is not an end in itself. The achievement of the three men whom you are honouring today was that they visualized in the middle of war a new conception of travel in peace, and to have led their project through some astonishing vicissitudes with a determination which is now yielding its due reward—a fine practical airliner coming and going easily and regularly from airports large and small all over the world, and a design team rich in experience. These men are already immersed in the problems of the second and third generation of jet airliners and their future successes will rest to a great extent on the leadership, foresight and single-mindedness of de Havilland, Walker and Halford."

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Comet in the Commonwealth

WE share fully in Mr. Barker's enthusiasm [Correspondence, September 25 and October 9] for the cause of British aviation in Australia, and for this reason we feel that some of his remarks about B.O.A.C.'s arrangements for bringing the Comet 4 to Australia need putting into perspective.

To take his last point first [in his September 25 letter], we did not "pick" the day after Princess Alexandra's arrival at Sydney to "race in a Comet to Mascot." We were well aware that to some extent the Royal visit obviously would overshadow the Comet; but to delay the first visit of the aircraft to Australia on those grounds would have involved changes in an urgent route-proving and training programme and might well have caused a delay in introducing the airliner into scheduled service.

We certainly made a concerted effort to ensure that the Comet 4 received the best possible reception in Australia—and results do not bear out Mr. Barker's charge that jets are no longer news to Australians. Regarding his statement that there was "hardly a word" in the Australian Press (there were several hundred, with pictures, in at least three Sydney papers), I think that we can reasonably claim that the Comet had a very fine reception, with major TV and radio coverage as well. Every facility, and the fullest technical information, was given to the Press present and to newspapers and radio systems throughout Australia.

It should be made clear that while we shall always do all we can to advance B.O.A.C.'s interests, a task of the Comet in Australia is to make the maximum possible contribution to our commercial partnership with Qantas. In the light of that need, any public recriminations about B.O.A.C. having "let" Qantas introduce their Boeing first are surely pointless and harmful to the interests of both airlines—and both countries, too.

Regarding Mr. Barker's second letter, I can only emphasize, firstly, that all too often it simply is not practicable to include details of a very flexible route-proving flying programme in an advertisement necessarily prepared well in advance.

In any event, I think that your correspondent answers his own complaint when he says that the Comet climbed so rapidly after take-off that he could not see it properly at all. That is precisely the objection to urging people to watch for an airliner which, when it passes overhead (if it does), is possibly travelling at 500 m.p.h. some eight miles high.

I repeat that we are at all times ready to do everything we can within reason to display the Comet to the public. But the very qualities that make it so impressive an aircraft also make it very difficult to display in its natural element.

London, W.1. F. C. GILLMAN,
Chief Press and Information Officer, B.O.A.C.

"Before the Wrights" Once Again

HERE we go again! I always dread this season, for it is the season of claims—among other things—to have flown before whoever it was that made the previous claim. Now we are back on the merry-go-round, and again it is a loyal brother who comes forward. Mr. D. W. Pearse of Timaru in New Zealand is quoted as saying: "I am quite sure that the honour of having flown the first heavier-than-air craft was my brother's. I can recall how disheartened he was when, having accomplished so much, he heard that the distinction—and the prize—was shared by the Wright brothers."

Mr. Pearse is also quoted as saying that it was acknowledged in America that his brother (the late Richard Pearse) had patented the wing and tail controls ahead of the Wright brothers, the acknowledgement being said to have appeared in the *Scientific American* magazine. "My brother," says Mr. Pearse, "was always mechanically minded. He had read that the *Scientific American* was offering the sum of £10,000 to the first man to fly a certain distance and he made up his mind to have a go. He made a 25 horse-power engine weighing 50 pounds which he claimed was the lightest engine in the world for its power. This was about 1900 . . . [the] eight-bladed propeller, the base of which was made from a cut-down sheep dip tin." The account says that "after the first trial it was found that the engine was not powerful enough to lift the craft, and his brother fashioned a 90 horse-power engine": "I turned the propeller," says Mr. Pearse, "and the machine went into the air."

There is a good deal more of this fascinating account, and this latest of claims has recently been given publicity in a lecture by Mr. George Bolt, chief engineer of Tasman Empire Airways Ltd. Mr. Bolt is said to be actively investigating the claim. Would he please get us the number, place of issue and details of this interesting patent, whilst I am writing to the Library of Congress about the *Scientific American* reference. Meanwhile, will Mr. Bolt please go and visit Mr. Pearse and tell him the following:—

(1) His brother would not have heard anything worth hearing about the Wrights' power-flying in 1903 until the end of 1907, and almost certainly not until August of 1908.
(2) The Wrights did not win any prizes until 1908.
(3) The *Scientific American* prize was not offered until 1908, and was won by Glenn Curtiss on July 4, 1908, in his *June Bug*.
(4) I can find no reference to his brother in any of the works I have consulted, and would much like to have such a reference.
(5) The Wrights never patented any "tail controls," but they did patent the *combined use* of a rear rudder and wing-warping, amongst other things.

In addition, would Mr. Bolt also ask if there are any extant photographs of this remarkable aircraft?

Echoes surround me as I write. In December 1953 the late Mr. J. Y. Watson claimed that his brother, the late Mr. Preston Watson, made a powered flight of between fifty and a hundred yards in 1903. After I had wasted an unconscionable time unearthing documents, and analysing photographs and descriptions, to show that this claim was untenable, Mr. Watson had to admit (in 1955) that Preston Watson's 1903 machine "was without an engine." I am now dealing with a claim from a member of my own family who asserts categorically that my esteemed grandfather made a powered, controlled and sustained flight of a mile in 1894. It is a particularly difficult claim to deal with as my aged aunt (who is making the claim) asserts categorically that she saw the flight, and bound up my grandfather's injured finger after he landed. What is more, she has triumphantly produced a faded photograph to prove her story: it shows an enormous machine with two airscrews, dihedral on the outer panels, and large fore and aft elevators: faintly discernible in pencil on the back of the print are the mysterious words "Baldwyns Park."

London, S.W.7. CHARLES H. GIBBS-SMITH.

Tailpiece: I have just heard from the Patent Office that they "can find no trace of any such patent by the man [Richard Pearse], either in our United Kingdom patent records, or in the name indexes of New Zealand patents for the period you mention" (i.e., 1895-1906).

Argosy in Manxland

AS doubtless you are aware, on October 2 one of the new Argosy freighters completed a delivery flight to the Isle of Man, carrying two tractors, a load of tyres and other goods. I was most impressed by the copy-book approach and touchdown on our main 270 runway here. It was so polished that one got the impression that the captain was using it as routine.

Most outstanding was the excellent braking effect from the prompt propeller-reversal. The aircraft had used well under half the available runway when finally halted—a most convincing demonstration of one aspect of its short-field performance. Turning off starboard, she taxied to the perimeter, then round the back of the control tower to her parking-area in front of the main building, with the lively agility of the much smaller Friendships we see so often here. The Argosy obviously handles superbly on the ground.

I envied those fortunates who were privileged to climb aboard her and drink it all in (as it were), but I found myself rather puzzled by one feature. This concerned an area of the upper fuselage behind the "office building," covered with a multiplicity of rectangular-form, blade-like protrusions set in regular pattern. Am I right in thinking this was some form of antenna system?

Port Erin, Isle of Man. D. G. DOBSON.

[The protrusions are turbolators, for improving airflow characteristics. Those of the Argosy were illustrated in a sketch on p. 325 of *Flight* for October 2.—Ed.]

FORTHCOMING EVENTS

Oct. 21. Brit.I.R.E. (Medical Electronics Group): "Electronic Instrumentation for Aviation Medicine," by P. V. Byford.
Oct. 21. Aircraft Recognition Society: "The Rotodyne," by Dr. H. Roberts.
Oct. 21. Institute of Navigation: "Off the Beaten Track—the Story of Radar," by Sir Robert Watson-Watt.
Oct. 21. Kronfeld Club: "The Italian Nationals," by Lt-Cdr. G. A. J. Goodhart.
Oct. 22. R.Ae.S. Astronautics and Guided Flight Section: "Problems of Interplanetary Navigation and Re-entry," by T. R. F. Nonweiler.
Oct. 22. R.Ae.S. (Isle of Wight Branch): "Air Traffic Control and Jet Operations," by H. E. Smith.
Oct. 27. R.Ae.S.: "Aircraft Fatigue," by R. J. Atkinson.
Oct. 27. Radar and Electronics Association: "Electronics in Supersonic Flight," by F. W. Page.
Oct. 28. Brit.I.R.E. (Radar Group): "An Historical Survey of Radar and Radio Aids to Aircraft Navigation," by Air Marshal Sir Raymund G. Hart.
Oct. 28. R.Ae.S. Graduates' and Students' Section: "Setting of Aircraft Specifications," by R. H. Whitby.
Oct. 29. R.Ae.S.: Special General Meeting, the Society and the Helicopter Association.

THE INDUSTRY

Countering Rubber Problems

FOR the past three years the Avon India Rubber Co. have published in September an *Aircraft Rubber Digest*, produced in a form similar to a famous digest with a different name and providing a quick guide to recent developments for aircraft (and missile) applications. The rubber industry's big problem is thermal: the usefulness of some of its products is becoming limited by the high ambient temperatures in which they are now required to work. Aircraft tyres, for example, may be heated to 200 deg C on touch-down; and if they have already been pre-heated to 120 deg C or more by skin friction, operation could become hazardous. New materials are being developed for high temperatures, and both butyl and silicone rubbers show promise, while nitrile rubbers can be expected to provide extended service at temperatures up to 165 deg C if they are protected from atmospheric oxidization.

Another range of rubbers, newly developed materials in the range of the fluorinated polymers, also show promise of giving good service at high temperatures and some exhibit a potential range of from −36 deg C to +315 deg C. But 540 deg C (1,000 deg F) is the current target and a major discovery in polymer technology—or the development of new inorganic materials—is required before a solution can be reached.

Much work has been done to improve the properties of silicone rubber since it was introduced as a new material 12 years ago, and an indication of this improvement is given in this table:—

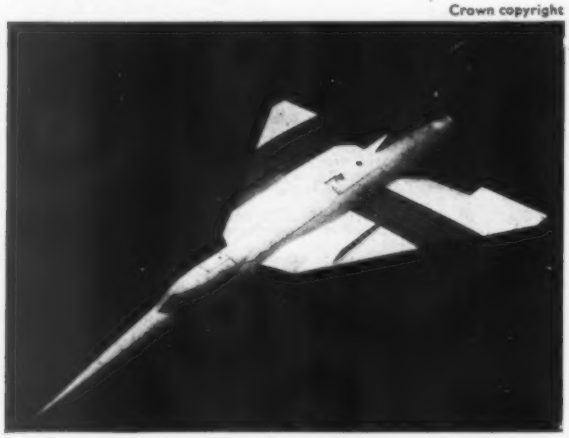
Grade of silicone rubber	Year of introduction	Tensile strength (B.S.903) lb/sq in	Elongation at break (B.S.903) per cent
A	1947	750	70
B	1949	700	280
C	1953	900	280
D	1957	1,500	555
Natural rubber	—	3,500	700

Recent applications are Tersil rubber-insulated cables covered with glass and polyethylene terephthalate to protect the silicone, and a new range of cold-curing silicone rubbers. The latter are heat-resistant up to 250 deg C and can be cured at room temperature by the addition of a liquid catalyst, when they become heat-stable products. Applications are for caulking and filleting, insulation, and encapsulating electronic components. A measure of the wide use of rubber in the aircraft industry is the claim of Spencer Moulton and the Avon group that their products were included in every aircraft which flew at the S.B.A.C. Show this year.

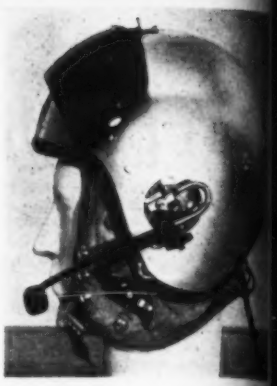
Crashable Models

A WELL-ESTABLISHED method of testing aircraft spinning characteristics is by the use of models launched from a balloon at about 3,000ft, a practice carried out by such research establishments as the R.A.E. Bedford. Constructional materials used for the models must allow a high degree of dimensional accuracy and stability, unaffected by variations in temperature and humidity, and they must be easily repairable. The present method of making them, using Araldite epoxy resins and glasscloth to provide a reinforced plastic, gives the advantage of high dimensional stability and enables the models to be used repeatedly. CIBA (A.R.L.) Ltd., the makers of Araldite, state that one model which was buried two feet underground was retrieved undamaged after one-and-a-half hours' digging.

Crown copyright



A spinning-test Fairey F.D.2 model (see news-item at foot of column



This helmet, equipped with a boom-mounted noise-cancelling microphone by Amplivox Ltd., of Wembley, Middx, is stated to be the first to be offered with such an attachment. The NATO-designated microphone unit is carried on a fully adjustable Service-approved boom and a sub-miniature switch is attached to the stud-fixing mounting block. The assembly can be supplied as a modification kit for Service-issue helmets

Air Trainers Changes

BOARD changes have been announced by Air Trainers L[td.] Ltd. Mr. J. M. Wallace has relinquished the chairman[ship] in order to reduce his commitments and so enable him to g[ive] more time to his other interests, and Air Chief Marshal Sir J[ohn] Baker, G.B.E., K.C.B., M.C., D.F.C., has been elected to [the] board and appointed chairman. There have been two other el[ec]tions to directorships, of Lt-Gen. Sir Frederick G. Wrisb[erg] K.B.E., C.B., and Mr. J. W. Murray, who is chairman of [the] General Precision Equipment Corporation of New York.

The company is to continue the design and manufacture [of] flight simulators and industrial control computers, but recom[mendations] have been made to the shareholders that its interes[ts] should be broadened and capital resources increased. Th[ese] developments would involve a change of name to Gener[al] Precision Systems Ltd.

The new chairman, Air Chief Marshal Sir John Baker, w[as] Controller of Aircraft, Ministry of Supply, from 1953 to 1956 a[nd] prior to that Deputy and then Vice-Chief of the Air Staff. Lt-Gen. Wrisberg is a former Controller of Supplies at the M.o.S.

IN BRIEF

Texas Instruments Ltd. have signed the contract for the construction of their new semiconductor plant, work on which will begin next year. Value of the project is some £1m and the contract has been awarded to Tarmac Civil Engineering Ltd.

Palmer Aero Products Ltd. of Penfold Street, London, N.W.1, announce that Mr. E. J. Fell has joined their sales department with responsibility for Palmer-Parmatic filters and filtration equipment. He was until recently with Vokes Ltd. and prior to that with the engine division of the Bristol Aeroplane Co. Ltd.

A new company specializing in the application of electronics to industry and education has been formed under the title Hursant Electronics Ltd., with offices at 13-14 The Mall, London, W.5. Senior executives are Mr. D. C. Adams and Mr. R. C. Lever, until recently sales manager and chief engineer respectively of Hivolt Ltd.

Vernons Industries Ltd. of Kirkby Industrial Estate, Liverpool, have issued a leaflet dealing with a range of transistorized automatic voltage regulators and voltage and frequency limiting relays developed for use with their ground power units. Another leaflet deals with the latest vertical motor alternator sets developed to meet the need for a readily transportable source of precise high-frequency power.

Mr. F. J. Jervis, B.Sc. (Eng.), A.M.Brit.I.R.E., A.M.I.W.M., has been appointed contracts manager of Nash & Thompson Ltd. He joined the company from the Ministry of Supply, where since 1951 he had been a production engineer on guided weapons. Nash & Thompson also announce that A. R. Bolton & Co., 3a St. Vincent Street, Edinburgh, 3 (tel. Caledonian 2065), have been appointed their sole agents in Scotland.

Smiths Aviation Division (Wembley, Middx) state that their range of synchros now includes over 20 different types and that an entirely new range of high-temperature Grade 1 synchros will shortly be available. The standard range falls into three main types, hysteresis, drag cup and induction: the size 07 induction motor is stated to be the smallest of its kind in production in this country. Also available in the full range are the BNC connectors and adaptors, which are lightweight, weatherproof and interchangeable with equivalent U.S. military types. Maximum current is 1 amp, voltage 500V peak and nominal impedance 50 ohms.

Three new directors have been appointed by Ferranti Ltd. They are Mr. E. Grundy, O.B.E., B.Sc. Tech. (Hons.), M.I.Mech.E., M.I.E.E., Mr. J. Prince, M.I.E.E., and Mr. O. M. Robson, M.A., M.I.E.E. Also Mr. W. D. H. Gregson has been appointed assistant general manager of the company's Edinburgh factory, and he is succeeded as London area manager by Mr. J. P. Newberry. Mr. P. McGregor becomes power transformer sales engineer, London area. Mr. J. C. Heywood has been appointed sales manager of the electronics department and is succeeded in the instrument department by Mr. H. L. Harrison as department sales manager.

ANNOUNCEMENT

XI